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## An Anthropometric Survey of 2000 Royal Air Force Aircrew, 1970/71

by

C.B.Bolton, M.Kenward,  
R.E.Simpson and G.M.Turner

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ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT  
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AN ANTHROPOMETRIC SURVEY OF 2000  
ROYAL AIR FORCE AIRCREW, 1970/71

by

C.B.Bolton, RAE  
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## FOREWORD

The Royal Air Force has for the last thirty years used measuring equipment, or improved versions of it, developed by Morant (Morant & Gilson, 1945 - Ref.1) towards the end of the 2nd world war. There have been slight changes in the definitions of each measurement, usually in order to improve the reproducibility and hence reliability of the measurement.

Comparison of the results obtained for body dimensions which were taken in the 1955 survey of 4557 RAF pilots (Samuel & Smith, 1965 - Ref.2) and this survey of 2000 RAF aircrew, show that there have been slight increases in mean stature, weight and sitting height but no significant change in buttock-knee length of the measured populations. There are, however, gross differences between the present RAF aircrew population and that of 1944 (sample of 500 RAF aircrew measured (Morant & Gilson, 1945 - Ref.1) as can be seen in the table of means given below.

**Comparison of Means of Certain Body Dimensions  
Obtained in RAF Aircrew Anthropometric Surveys**

	1944	1955	1966	1970/71
Stature (mm)	1739.9	1771.7	1769.6	1774.4
Weight (kg)	65.9	71.9	74.3	75.0
Sitting height (mm)	918.5	931.9	926.6	936.0
Buttock-knee length (mm)	592.3	607.3	607.6	607.6

However, the anthropometric limitations on aircrew entrants had been relaxed during the second world war, perhaps accounting for much of these differences. The 1965 survey (Simpson & Bolton, 1970 - Ref.3) involved relatively few subjects (200) and was undertaken on an opportunity basis during a large scale clothing fitting trial.

To allow comparison of the data obtained in this 2000 aircrew survey with that obtained in surveys conducted using the standard anthropometer and the technique developed by Hertzberg (Hertzberg et al, 1963 - Ref.4) Hertzberg et al, 1954 - Ref.5), four measurements, namely, stature, sitting height, biacromial breadth and buttock-knee length, were also taken with the standard anthropometer. The correlation coefficients between the techniques were 0.996, 0.956, 0.909 and 0.930 respectively. It must be pointed out that when making comparisons of surveys using differing measuring equipment one must pay particular attention to the detailed definition of the relevant measurement.



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# 1 INTRODUCTION

## 1.1 Background and acknowledgments

This anthropometric survey of 2000 Royal Air Force aircrew was sponsored by the Ministry of Defence Aircrew Equipment Research and Development Committee (AERDC) in response to the recommendations of Engineering Physics Department, Royal Aircraft Establishment (RAE), Farnborough, and the Royal Air Force Institute of Aviation Medicine (IAM), Farnborough.

The measuring phase was undertaken under Ministry of Defence (Procurement Executive) contract by Loughborough University and the contribution of the Loughborough measuring team, Pamela Hunt, Sue Pullen and Martin Kenward, in the tedious but important task of collecting the basic data is gratefully acknowledged.

Pre-survey planning and measuring programme organisation and management was the responsibility of a co-ordinating Committee under the Chairmanship of Wg. Cdr. J. Ernsting, OBE, RAF, IAM. The Committee consisted of the following members:

Mr. C. B. Bolton	Engineering Physics Department, RAE
Wg. Cdr. B. H. Rance	Aviation Medicine Training Centre, RAF North Luffenham
Mr. R. E. Simpson	Engineering Physics Department, RAE
Mr. G. M. Turner	RAF IAM
Mrs. J. S. Ward	Loughborough University

In a programme of this magnitude it is acknowledged that the successful completion of the project has depended upon the efforts of many contributors - 2000 of whom shall be nameless. Their support together with the co-operation of the Royal Air Force Commands, Station Commanders and appointed Station Liaison Officers is gratefully acknowledged. The authors also acknowledge the work of Miss H.M. Ferres of IAM who was responsible for the statistical design of the survey and its associated training and validation programmes. Last, but by no means least, the authors' thanks for the diligent and continuing work of Miss E.V. Hartley of Mathematics Department, RAE, in the computer programming of the data are gratefully recorded.

## 1.2 Previous surveys

The existing anthropometric information on British military aircrew stems primarily from three studies. A survey in 1944 of eight measurements on 550 Royal Air Force aircrew (Morant and Gilson 1945)<sup>1</sup>, a survey in 1955 of seven measurements on 4357 Royal Air Force pilots (Samuel and Smith 1965)<sup>2</sup>, and a survey in 1966 of forty-four measurements on 200 Royal Air Force and Royal Navy aircrew (Simpson and Bolton 1970)<sup>3</sup>.

The 1944 survey related to the war-time RAF aircrew population where some of the anthropometric limitations on aircrew entrants had been relaxed. Its major purpose was the acquisition of data for functional clothing sizing. The 1955 survey provided information relevant to cockpit workspace measurements and those data set the current standards of UK military aircraft requirements. The 1966 survey was undertaken on an opportunity basis during a large-scale clothing fitting trial. It involved many more measurements than the earlier surveys but the number of subjects was relatively small.

## 1.3 1970/1971 survey

Body measurements of military aircrew are needed for two main purposes:

- (a) to determine cockpit workspace requirements, and
- (b) for the sizing of aircrew functional clothing.

Apart from the requirement for a general updating of existing information there was a need for data on many aircrew measurements not hitherto obtained. This is a consequence of the reduction of aircrew workspace in high performance military aircraft and, to an even greater extent, the increased complexity of functional clothing assemblies and of escape and control systems. These needs have been met by the 1970/1971 survey of Royal Air Force aircrew.

In this survey a team of two trained measurers, using a specially designed anthropometric rig, took 62 measurements of each of 2000 subjects between the ages of 18 and 45 at eighteen Royal Air Force stations in England. The measuring was conducted in a self-contained mobile laboratory.

## 1.4 Apparatus

The anthropometric rig which was used for the 1966 survey of 200 British military aircrew (Simpson and Bolton, 1970) was designed to enable body measurements to be taken more easily, and so reduce fatigue in both subject and



operator. A modified version of that rig was adopted for the 1970/1971 survey. During preliminary training of the measurers for this survey, both standard anthropometers and this RAE rig were used. The rig was again found to be not only easier to use but also quicker and at least as accurate.

A head measuring rig and hand-held calipers were also developed for the survey since existing equipment is cumbersome and awkward to read.

To allow comparisons of the results of the present survey with previous surveys, in particular results from the USA, some measurements were repeated using a standard anthropometer and the techniques of Hertzberg (Hertzberg *et. al.*, 1963 <sup>4</sup>; Hertzberg *et. al.*, 1954 <sup>5</sup>).

### 1.5 Sociological data

Some sociological data were obtained from this survey as indicated by the questions included in the survey proforma reproduced at Fig.1. This information was obtained for purposes outside the main scope of the survey and is therefore not included in this Report.

### 1.6 Choice of measurements

The measurements taken in the survey were chosen to cover the requirements for aircrew clothing, personal equipment and cockpit workspace design purposes. They were selected after consultation with the relevant manufacturing and research organisations. Four of the measurements (results shown in Tables 63 to 66) were introduced after commencement of the survey to meet specific needs which arose in relation to particular equipment developments.

### 1.7 Further analyses

This Report summarises the recorded data in the form of a percentile table together with the mean, the standard deviation, the range and the coefficient of variation for each measurement. It is proposed to investigate the relationships between two or more measurements and the application of the data to aircrew clothing, protective headgear and cockpit workspace sizing and design. Comparison of the data will be made with that of earlier anthropometric surveys. This work will be reported in due course.

## 2 SURVEY DETAILS

### 2.1 Sample

The sample comprised 2000 Royal Air Force aircrew including all ranks below Group Captain and with ages ranging from 18 to 45 years.

The composition of the current RAF aircrew population was determined with respect to age, crew duty and operational role. The stations at which aircrew were to be measured were chosen to give a sample representative of the whole for these categories. A close watch was maintained to ensure that the stratified sampling conformed with the overall proportions.

The resulting sample consisted of 1028 pilots, 613 navigators and 359 other flight deck aircrew; the latter category included air electronics officers and operators, signallers, engineers and radio observers.

### 2.2 Team of measurers

Initially three graduates were trained for measuring so that there was a team of two measurers with one reserve. Following a period of several weeks measuring, during which the techniques and sequence of measurement were determined, there was a formal exercise to assess the reproducibility of the measurements taken by the three measurers. Six subjects were each measured on three occasions by each measurer. The statistical design was such that each subject was measured only once on any one day. The team continued practicing until the beginning of the survey six weeks later.

During the entire period of the survey the standard of measuring acquired whilst training was monitored by remeasuring, whenever possible, one subject each day. In this way minor errors were detected and the necessary corrective action taken.

After four months the need arose to recruit and train a replacement measurer. The team trained the new member for a week until it was ascertained that he had reached the standard of accuracy of the existing team.

### 2.3 Conduct of survey

A preliminary visit was normally made by representatives of the co-ordinating committee to each station at which aircrew were to be measured one month before the planned arrival of the survey team.



Each station appointed a liaison officer to organise the daily programme of twelve half-hourly sessions; one of these sessions being set aside for remeasurement of one of that day's subjects. The officer was supplied with information sheets for distribution to the squadrons and with aircrew briefing sheets which detailed the purposes of the survey and gave aircrew notice of what their involvement entailed.

On arrival at the mobile laboratory the subjects changed into standard briefs whilst giving certain personal details to the team. The measuring sequence took approximately twenty minutes for each subject.

The two members of the team alternately measured and recorded to reduce fatigue to a minimum. The recorder verbally confirmed each measurement before entering it on the proforma.

Completed data proformae were returned to RAF IAM or RAE by the team weekly for checking and processing. The team also returned a fortnightly progress report to the co-ordinating committee.

#### 2.4 Data recording and processing

The data were recorded on a proforma (Fig.1) from which they were transferred to ICL punched cards. Weights were recorded to the nearest half kilogram; skinfold measurements in tenths of a millimetre, and all other dimensions in millimetres.

All data were scrutinised for omissions and obvious errors, and where errors were apparent the values were deleted. A further check was made by computing percentile tables independently for each of the ten subsamples of 200 as well as for the complete 2000 sample.

#### 2.5 Check measurements

Check measurements were made at the rate of 7 in every 100 subjects. This involved repetition of the whole measuring procedure. Approximately two-thirds of these were repetitions made by the other member of the measuring team, the remaining one-third being check measurements by the same member. This was to permit the assessment of intra and inter-measurer errors. The linear regressions between the corresponding values for a pair of measurers was calculated. The maximum deviation from the ideal perfect relationship was then derived over the first to the ninety-ninth percentile range. This value is given with the other calculated statistical values for most measurements and is also expressed as a percentage of the mean.



## 2.6 Statistical summaries

The data are summarised separately for each measurement with a definition and a photograph(s) of the technique employed, a table of percentile values and the calculated statistics. The calculated statistics given are:

Mean  
Standard deviation  
Coefficient of variation  
Range  
Number of subjects.

In addition there is a value, defined under Check Measurements (section 2.5), representing error between measurers.

## 3 APPARATUS

### 3.1 Mobile laboratory

A 10 ton Leyland Hippo with caravan body (Fig.2) was fitted out as a mobile anthropometric laboratory and all measuring equipment installed therein. The plan of the laboratory is shown in Fig.3. The floor was fully carpeted, heaters and fans fitted and cupboards provided for storage. There were two curtained changing cubicles, chairs and a writing surface for the subjects' use in completing the personal details on the proforma. A table and chair for the recorder were situated so that the scales on the measuring rig could be seen by the recorder and the measuring monitored (Figs.3, 4 and 5).

### 3.2 Body measuring rig

The body measuring rig (Fig.6) consists essentially of an end wall, a back wall and a floor mutually at right angles. A vertical track, parallel to the end wall, slides in horizontal tracks at the top and bottom of the rear wall. A carriage slides in the vertical track and carries two datum probes whose measuring faces abut. The probes (Figs.7 and 8) can be rotated through  $90^{\circ}$  so that the datum faces are either parallel with the floor for measuring heights or parallel with the end wall for measuring widths. On the carriage and at the top of the vertical track are vernier scales with 2mm divisions which are read against scales of centimetres on the vertical track and at the top of the back wall. (This open scale system permits easy, rapid and direct reading to the nearest millimetre of the distance of the probe from either the end wall or the floor.) The verniers can be adjusted for calibration.

There are two mirrors incorporated in the rig. One is behind a perspex panel set in the end wall (Fig.6) and has its base against the bottom of the end wall and is held at approximately  $20^{\circ}$  from the vertical. This mirror enables the measurer to check body pressure against the end wall by monitoring the area of flesh flattened against the perspex panel. The second mirror is set in the back wall of the rig and is used to monitor the run of the tape around the subject's back when measuring chest circumference. A third mirror is fastened to the wall of the caravan opposite the measuring rig so that the subject can look into the reflection of his own eyes to ensure a level horizontal gaze whilst sitting height is being measured. A fourth mirror on a stand is mounted opposite the head measuring rig (Fig.5) so that the subject can look into the reflection of his own eyes whilst head measurements are taken.

The walls of the rig are formica faced for ease of cleaning and the floor is covered with granulated sheet cork for the benefit of the barefoot subjects. Three different colour pairs of footprints are painted on the floor to reduce the amount of spoken instructions necessary to position the subject where required. A cross shows where to sit for buttock-heel length measurement which is accomplished with a sliding block (Fig.9) against a scale inset in the front of the rig floor. The measuring area is lit by a 5ft fluorescent tube mounted on one of the two rig top bracing bars.

A hydraulic jack mounted on a circular wooden base and having a hard, flat, square, plastic coated top sitting platform is used as an adjustable height stool (see photograph at Table 11). Ankle and leg circumferences are taken for convenience with the subject standing on a second stool at a fixed height of approximately 300 mm.

### 3.3 Head measuring rig

The head measuring rig (Fig.10) is mounted on a track on the outer edge of the end wall of the main measuring rig (Fig.6). It is counter weighted and can be locked at any required height by means of cam locks.

The rig consists of a vertical back wall and horizontal roof panel of  $\frac{1}{2}$  in perspex, the inner surfaces of which are the datum faces. A horizontal probe slides in a carrier suspended from the roof on two pairs of parallel motion arms jointed so that a moving scale attached to the carrier is always vertical and crosses at  $90^{\circ}$  a scale along the edge of the roof panel. The datum edge of the probe is formed by the intersection of two datum faces at  $90^{\circ}$  to



each other at the centre line of the probe spindle. The fourth mirror is vertically mounted so that the subject can look horizontally into the image of his own eyes during head measurement to ensure a consistent head attitude. When the subject's head is aligned and in light contact with the back wall, the rig is lowered on its track until the roof panel firmly contacts the head of the seated subject and is then locked in position. The probe is then traversed to contact the required head feature and its distance from the rig datum faces is read directly from the appropriate scales.

### 3.4 Head caliper

The head caliper (Fig.11) consists of a beam with two tubular arms perpendicular to it. One of these is mounted at the end of the beam and is fixed in position; the second arm, which is spring loaded, slides along the beam over the full scale graduation. Each of the two arms carries a measuring pad which may be rotated through  $180^{\circ}$  according to whether a flat disc (40 mm in diameter) or a ball end (6 mm in diameter) is required. Fine adjustments of the sliding arm are made by means of a knurled thumb wheel.

### 3.5 Body width caliper

The body width caliper (Fig.12) is similar in design to the head caliper except that the arms are of hollow square section and each carries a perspex datum face (230 mm  $\times$  90 mm).

### 3.6 Foot measuring box

The foot measuring box (Fig.13) consists of a base with two vertical walls forming a right angle. Two blocks slide in channels with their datum faces parallel to their opposing walls, which have the zero points of the appropriate centimetre scale for each datum face. A vernier scale with 2mm divisions is mounted on each block.

### 3.7 Measuring tapes

Two glass cloth tapes (Fig.14) 10mm wide were used for measuring circumferences. The tape used for head and body circumferences is 1.5m long with brass tab ends. The other tape, used only for vertical trunk circumferences, is 2m long with a rectangular metal loop attached to the zero end of the tape through which the distal end of the tape is passed.



### 3.8 Knee block

Two perspex blocks, the smaller of the two being 75mm long, are joined at right angles to form the knee block (Fig.15). The knee block is used to mark a position on the upper thigh 75mm proximal to the front of the knee cap and is placed on the knee with the long face aligned with the shin. The short extension of the long face is used as the datum for measuring buttock-knee length (see photograph accompanying Table 4).

### 3.9 Body marking template

The template (Fig.16) used for the shoulder and waist marks (see Body Mark Definitions) is made from perspex sheet. It has two arms the inner edges of which are 180mm apart; the mid-point of the template is clearly engraved.

### 3.10 Waist belt

The 15mm wide 'velcro' waist belt is shown in Fig.17.

### 3.11 Harpenden skinfold caliper

The Harpenden skinfold caliper (Fig.18) exerts an almost constant pressure of  $10 \text{ g/mm}^2$  at all jaw openings. The anvils have a contact area of approximately  $90 \text{ mm}^2$ .

### 3.12 Standard anthropometer

The standard anthropometer (Fig.19) is composed of four equal sections which make up a rod 2m long and calibrated in millimetres.

The datum probes are mounted by means of sleeves on this rod, the upper of these two being fixed in position and the second one free to slide along the rod. A second scale on the top two sections of the rod is used when these sections are used separately, with the two probes, as a caliper.

### 3.13 Weighing machine

A platform pedestal spring weighing machine with a dial graduated in kilograms to 125 kg was used for weighing subjects to the nearest  $\frac{1}{2}$  kg.

### 3.14 Clothing

The briefs used in the survey were of a standard 'continental' pattern in thin stretch nylon.

### 3.15 Use and maintenance of apparatus

Both the vertical and horizontal scales of the body measuring rig were calibrated using a 2m steel rule after each vehicle move and periodically during an extended stay. In the case of any discrepancy adjustment was made by moving the appropriate vernier scale. The probe was also checked for any slackness by measuring vertically from the floor to three positions along the length of the probe. The glass cloth tapes were also checked against the rule, but no discrepancies were found. Three 25kg weights were used to check the weighing machine and adjustment was made when necessary. Moving parts of the equipment were lubricated periodically and the tapes and all rig surfaces were kept clean and disinfected.

## 4 GLOSSARY OF TERMS AND DEFINITIONS

### 4.1 Definition of postures

#### 4.1.1 Standing erect

Subject stands comfortably erect but not rigidly to attention. The weight is equally distributed on both feet which are approximately 100mm apart.

#### 4.1.2 Sitting erect

Sitting comfortably erect on the stool with the trunk straight. The stool height being so adjusted that the line from the trochanter to the epicondyle is horizontal, the feet flat on the floor and the shins vertical.

#### 4.1.3 Sitting (head measuring rig)

Sitting on the stool, head forward facing, with the top and back of the head in firm contact with the head box datum faces.

#### 4.1.4 Head forward facing

Head comfortably erect, eyes looking into their reflection in the vertical mirror opposite.

#### 4.1.5 Skinfold measurements

Standing erect with shoulders relaxed. A parallel sided fold of skin is lifted away from the appropriate underlying muscle. The caliper jaws are placed 10 mm below the fingers of the measurer, excluding any superficial veins. The reading is taken after 5 seconds.

## 4.2 Measuring terms

### 4.2.1 Measurement from datum probe

Measurements using the datum probe, unless stated otherwise, are taken with light pressure applied at the point of body contact. Care is taken not to indent the flesh.

### 4.2.2 Measurement with tape

Tape measurements, unless stated otherwise, are taken with the tape tension such that the flesh is not significantly indented.

### 4.2.3 Alignment of the tapes

Wherever possible the calibrated edge of the tape is aligned with the line of the required measurement.

## 4.3 Body marks (see visual index, Fig.22a)

Each subject is marked with a felt-tipped pen to provide landmarks for the subsequent measurements. Unless otherwise stated, this is done with the subject standing erect, shoulders relaxed and arms at the side.

### 4.3.1 Waist marks (serial numbers 0001 to 1662)

The measurer places a firmly fitting 'velcro' belt around the subject's trunk at the approximate level where a trouser waist band would come. The subject moves the 'velcro' belt to the preferred height of the waist adjustment tabs on a flying coverall. Six horizontal marks are made on the skin adjacent to the lower edge of the 'velcro' belt. These are placed at the ventral and dorsal mid-lines, 90 mm to the left of the ventral and dorsal mid-lines, and on the two lateral surfaces. By aligning a template (Fig.20) with each of the mid-lines, vertical marks are made 90 mm from the dorsal and ventral mid-lines crossing the horizontal lines.

### 4.3.2 Waist marks (serial numbers 1663 to 2013)

A firmly fitting 'velcro' belt is placed around the trunk in the natural waist indent parallel to the floor. Six horizontal marks are made on the skin adjacent to the lower edge of the 'velcro' belt. These are placed at the ventral and dorsal mid-lines, 90 mm to the left of the ventral and dorsal mid-lines and on the two lateral surfaces. By aligning a template (Fig.20) with each of the mid-lines, vertical marks are made 90 mm from the dorsal and ventral mid-lines crossing the horizontal lines.



#### 4.3.3 Shoulder marks

A template is placed on the shoulders and a mark is drawn on each shoulder 90 mm from the mid-line (Fig.21).

#### 4.3.4 Acromial mark

The lateral edge of the acromial spine of the left shoulder blade is found by palpation and a parallel line is drawn 10 mm down from it.

#### 4.3.5 Cervicale mark

A horizontal mark is made over the spine of the seventh cervical vertebra (Cervicale). Where possible this is found by palpation with the head erect. Otherwise the head is bent forward enabling the bone to be located more easily: the head is then returned to the erect posture and a mark made.

#### 4.3.6 Wrist mark

A mark is made at the distal end of the styloid process of the left radius.

#### 4.3.7 Knee mark

Sitting erect. The knee block is positioned on the knee and a mark made on the upper surface of the thigh 75 mm from the front of the knee.

#### 4.3.8 Skinfold marks

With arms hanging, the point of the lateral epicondyle of the left humerus is marked (elbow mark). A tape is used to find the mid-point between this mark and the acromial mark and a horizontal line is drawn over the biceps and triceps through this mid-point. The horizontal line crosses a vertical line drawn over the belly of the contracted biceps.

A mark is made 25 mm medial and 10 mm superior to the anterior superior iliac spine.

#### 4.4 Anatomical terms

Biceps	The muscle which lies in front of the bone of the upper arm (the humerus).
Cervical vertebrae	The bones of the spine in the neck.
Cuneiform bones	The three bones which form the medial part of the bony structure of the middle of the foot.
Deltoid muscle	The muscle which lies over the lateral surface of the shoulder joint and of the upper part of the bone of the upper arm.

Distal	Farthest from the median line; farthest from the trunk or point of origin.
Epicondyle of humerus	The bony prominences on the lateral and medial aspects of the distal end of the bone of the upper arm at the level of the elbow.
External oblique muscle	The most superficial muscle of the anterior abdominal wall passing from the lower part of the rib cage above to the groin and pelvis below.
Gluteal fold	The furrow between the buttock above and the back of the thigh below.
Larynx	The cartilaginous walled cavity at the top of the wind-pipe in the front of the neck which contains the vocal cords.
Lateral	Away from the mid-sagittal plane of the body.
Malleoli	The bony prominences on the lateral and medial aspects of the distal end of the lower leg at the ankle.
Medial	Nearer to the median or mid-sagittal plane.
Mid-sagittal plane	The vertical plane through the long axis which divides the body into right and left halves.
Menton	The lower edge of the tip of the chin in the mid-sagittal plane.
Metatarsals	The five long bones which form the distal part of the foot - lying parallel to each other and to the long axis of the foot immediately proximal to the toes.
Nasion	The point of maximum depression in the mid-sagittal plane at the junction of the nose and the forehead.
Occiput	The bony prominence of the back of the skull.
Perineum	The region at the lower end of the trunk between the thighs which is bounded in front and behind by the bony pelvis.
Proximal	Nearest to the trunk or point of origin.
Radius	The lateral bone of the two bones of the forearm (when the palm of the hand is facing forwards).
Superior iliac spine	The anterior end of the crest of the hip bone - at the upper outer end of the groove of the groin.
Styloid process of ulna	The most distal part of the ulna bone which lies towards the back of the wrist.

Tragion	The notch in the cartilage of the ear just above and immediately in front of the ear hole.
Triceps	The muscle which lies behind the bone of the upper arm (humerus).
Trochanter	The lateral bony protuberance at the upper end of the thigh bone at the level of the hip joint.
Ulna	The medial bone of the two bones of the forearm (when the palm of the hand is facing forwards).
Vastus medialis	The muscle on the medial side of the thigh.
Vertebral border of scapula	The medial edge of the shoulder blade.

## 5 RESULTS

The data are presented in the form of percentile tables which are indexed in the Report contents list. 62 of the tables are the result of direct body measurements. The remainder, Tables 63 to 88, are derived by addition or subtraction of two or more direct measurements and the computation of the resulting quantities.

Table 89 is a summary of the data included for convenience of rapid consultation. It lists the mean, min, 1st, 3rd, 97th and 99th percentiles and the max of each of the preceding 88 tables.

For ease of reference a pictorial index is included as Figs.22a to 22e at the end of the Report.



# REFERENCES

<u>No.</u>	<u>Author</u>	<u>Title, etc.</u>
1	G.M. Morant J.C. Gilson	A report on a survey of body and clothing measurements of Royal Air Force personnel. FPRC 633(a) (1945)
2	G.D. Samuel E.M.B. Smith	A comparison of seven anthropometric variables of American, British and Canadian pilots. IAM R322 (1965)
3	R.E. Simpson C.B. Bolton	An anthropometric survey of 200 RAF and RN aircrew and the application of the data to garment size rolls. HMSO R&M 3612 (1970) (also RAE Technical Report 67125 (1968))
4	H.T.E. Hertzberg E. Churchill C.W. Dupertuis R.M. White A. Damon	Anthropometric survey of Turkey, Greece and Italy. NATO AGARDograph 73, Pergamon Press (1963)
5	H.T.E. Hertzberg G.S. Daniels E. Churchill	Anthropometry of flying personnel. WADC Technical Report 52 - 321 (1954)

## Guide to Users

1 The statistical terminology used in this Report is defined as follows:

(i) MEAN

The arithmetic mean of a set of data ( $\bar{x}$ ) is calculated by adding together all the observations and dividing the sum by the number of observations. If  $x$  is a variable with values  $x_1, x_2, x_3, \dots, x_n$  then the arithmetic mean of 'n' of such values is the sum of the various values of  $x$ , which is denoted as  $\Sigma x$ , divided by 'n', the number of them.

$$\bar{x} = \frac{\Sigma x}{n} .$$

(ii) STANDARD DEVIATION (AND VARIANCE)

The variance of a set of data ( $s^2$ ) is so that:

$$s^2 = \frac{\Sigma (x - \bar{x})^2}{n-1} .$$

The square root of the variance, i.e.  $s$ , is called the standard deviation and this has the advantage of being in the same dimension as the observations. It is a measure of the variability or dispersion of a set of data.

(iii) COEFFICIENT OF VARIATION

The coefficient of variation of a set of data is simply the standard deviation expressed as a percentage of the mean and is given by:

$$\frac{s}{\bar{x}} \times 100$$

(iv) RANGE

The range of a set of data is the difference between the largest observation ( $x_n$ ) and the smallest observation ( $x_1$ ).  $x_n$  and  $x_1$  are given in this Report.

Any statistical text book will give guidance on the use on the above statistics.

2 Before applying the data, read carefully the definition of the measurement paying particular attention to the posture adopted by the subjects when being measured. It is important to appreciate that the survey was carried out using nude subjects, in postures which do not reproduce directly those of aircrew dressed in full aircrew equipment assemblies strapped in an aircraft seat.

3 The data are presented in this Report, for each measurement independently, in a simple and standard form, i.e. selected percentiles, the mean, standard deviation and coefficient of variation. It is often necessary, when applying the data to aircrew functional clothing and cockpit workspace problems, to consider the relationships between two or more measurements. Bivariate and trivariate information is now available and will be reported in due course. Meanwhile the authors will be only too pleased to give advice and supply information on the relationships between two or more measurements.

4 One must be careful when talking in such terms as the 3rd or the 99th percentile aircrew. It is necessary to say exactly what measurements are implied. For example it is possible for a pilot with a sitting eye height corresponding to the 3rd percentile value to have arm or leg lengths as high as the 85th percentile values.

5 Studies have been made to determine the effects of various aircrew equipment assemblies and variation in seat pan and back rest geometry on sitting height, sitting eye height, effective arm reach, effective leg reach and on the ejection envelope. The data are currently under evaluation and will be reported in the near future.

TABLE 1

## WEIGHT

Standing on spring scale.

## PERCENTILE VALUES

%	kg	lb
1	55.75	122.90
2	58.38	128.71
3	59.46	131.08
5	61.41	135.38
10	63.90	140.88
15	65.87	145.21
20	67.43	148.65
25	68.80	151.68
30	69.96	154.23
35	70.99	156.51
40	71.99	158.72
45	73.34	161.68
50	74.46	164.15
55	75.75	166.99
60	76.90	169.54
65	78.27	172.56
70	79.44	175.13
75	80.94	178.45
80	82.44	181.75
85	84.32	185.88
90	86.37	190.41
95	90.01	198.45
97	92.42	203.75
98	93.88	206.97
99	96.50	212.75

Mean: 75.04 kg; 165.43 lb

Standard deviation: 8.81 kg;  
19.42 lb

Coefficient of variation: 11.74%

Range: 51.00 - 109.00 kg;  
112.44 - 240.30 lb

Number of subjects: 1998

TABLE 2

## AGE

## PERCENTILE VALUES

%	Year
1	19.89
2	20.25
3	20.57
5	21.15
10	22.52
15	23.61
20	24.55
25	25.60
30	26.41
35	27.07
40	27.82
45	28.70
50	29.79
55	31.06
60	32.35
65	33.68
70	35.09
75	36.30
80	37.36
85	38.31
90	39.75
95	41.59
97	42.90
98	43.70
99	44.63

Mean: 30.76 yr

Standard deviation: 6.49 yr

Coefficient of variation: 21.09%

Range: 18.67 - 45.92 yr

Number of subjects: 1999

TABLE 3

## FUNCTIONAL REACH

Sitting erect with back and buttocks firmly against perspex panel; equal pressure of shoulders against panel (monitored from mirror). Arms extended horizontally with forefinger and thumb opposed, thumb in line with extended arms. Measurement from end wall to datum probe at tip of left thumb.

## PERCENTILE VALUES

%	mm	in.
1	722.0	28.42
2	729.7	28.73
3	735.6	28.96
5	744.6	29.31
10	756.6	29.79
15	763.5	30.06
20	770.2	30.32
25	776.6	30.58
30	782.0	30.79
35	787.3	31.00
40	791.5	31.16
45	795.7	31.33
50	800.1	31.50
55	804.7	31.68
60	810.0	31.89
65	815.2	32.09
70	820.1	32.29
75	825.1	32.48
80	830.5	32.70
85	837.5	32.97
90	845.9	33.30
95	859.2	33.83
97	871.1	34.30
98	878.0	34.57
99	889.4	35.01

Mean: 801.7 mm; 31.56 in.

Standard deviation: 35.8 mm; 1.41 in.

Coefficient of variation: 4.46%

Range: 678.0 - 946.0 mm; 26.69 - 37.24 in.

Number of subjects: 1996

Check measure deviation: 8.7 mm; 1.1%

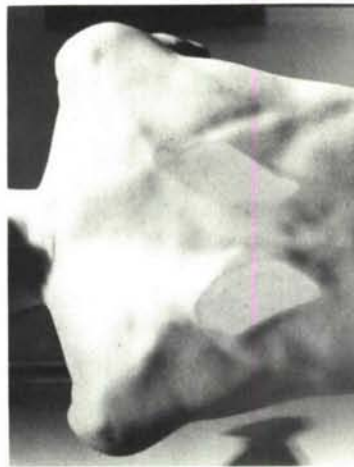




TABLE 4

BUTTOCK-KNEE LENGTH

Sitting erect with back and buttocks firmly against end wall, thighs parallel to rear wall and feet flat on floor. Knee block placed vertically on left knee against patella. Measurement from end wall to datum probe at knee block datum face.

PERCENTILE VALUES

%	mm	in.
1	549.6	21.64
2	554.6	21.83
3	557.9	21.96
5	563.9	22.20
10	573.4	22.58
15	579.2	22.80
20	583.5	22.97
25	588.0	23.15
30	592.4	23.32
35	596.6	23.49
40	599.9	23.62
45	603.3	23.75
50	606.5	23.88
55	609.7	24.00
60	613.6	24.16
65	617.4	24.31
70	621.3	24.46
75	625.7	24.63
80	629.9	24.80
85	634.7	24.99
90	641.4	25.25
95	652.4	25.69
97	658.5	25.93
98	663.8	26.13
99	671.7	26.45

Mean: 607.6 mm; 23.92 in.  
Standard deviation: 26.9 mm; 1.06 in.  
Coefficient of variation: 4.42%  
Range: 515.0 - 693.0 mm; 20.28 - 27.28 in.  
Number of subjects: 2000  
Check measure deviation: 7.4 mm; 1.2%

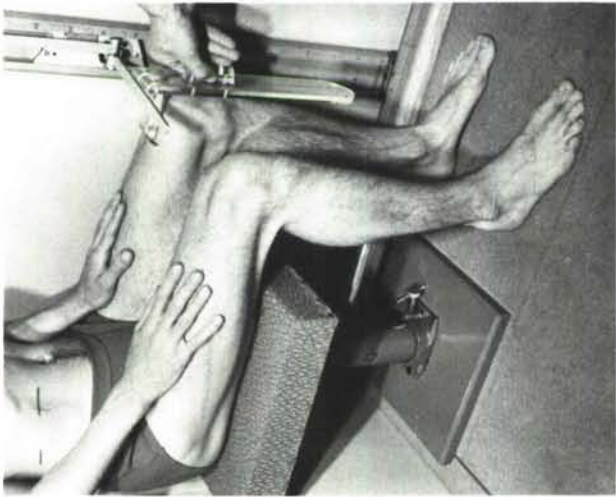


TABLE 5  
KNEE HEIGHT, SITTING

Sitting erect with back and buttocks firmly against end wall, thighs parallel to rear wall, shins vertical and feet flat on floor. Measurement from floor to datum probe at left knee mark.

PERCENTILE VALUES

%	mm	in.
1	505.3	19.89
2	511.3	20.13
3	513.9	20.23
5	518.5	20.41
10	525.9	20.71
15	531.5	20.92
20	536.0	21.10
25	541.1	21.30
30	545.3	21.47
35	549.0	21.61
40	551.9	21.73
45	555.2	21.86
50	557.5	21.95
55	560.2	22.05
60	563.6	22.19
65	567.2	22.33
70	571.1	22.48
75	574.9	22.64
80	578.9	22.79
85	583.8	22.98
90	590.6	23.25
95	602.0	23.70
97	610.0	24.02
98	615.7	24.24
99	622.5	24.51

Mean: 558.9 mm; 22.00 in.  
Standard deviation: 25.4 mm; 1.00 in.  
Coefficient of variation: 4.54%  
Range: 453.0 - 662.0 mm; 17.83 - 26.06 in.  
Number of subjects: 2000  
Check measure deviation: 3.5 mm; 0.6%



TABLE 6

## SITTING HEIGHT

Sitting erect with head forward facing and shoulders relaxed, back clear of rear wall. Elbows held lightly against sides with hands on mid-thighs. Measurement from floor to datum probe at vertex. Sitting height derived by subtraction of stool height from this measurement.

## PERCENTILE VALUES

%	mm	in.
1	864.7	34.04
2	871.4	34.31
3	876.2	34.50
5	883.4	34.78
10	895.3	35.25
15	903.0	35.55
20	909.1	35.79
25	914.6	36.01
30	919.6	36.20
35	924.7	36.41
40	928.8	36.57
45	932.6	36.72
50	936.2	36.86
55	939.5	36.99
60	943.7	37.15
65	947.4	37.30
70	951.7	37.47
75	957.3	37.69
80	962.2	37.88
85	967.8	38.10
90	973.9	38.34
95	986.1	38.82
97	992.3	39.07
98	998.0	39.29
99	1007.0	39.65

Mean: 936.0 mm; 36.85 in.  
Standard deviation: 31.0 mm; 1.22 in.  
Coefficient of variation: 3.31%  
Range: 824.0 - 1026.0 mm; 32.44 - 40.39 in.  
Number of subjects: 2000

Check measure deviation: 6.4 mm; 0.7%

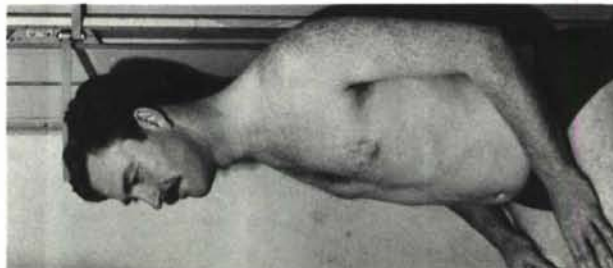


TABLE 7

## SHOULDER HEIGHT, SITTING

Sitting erect with shoulders relaxed, back clear of rear wall. Elbows held lightly against sides with hands on mid-thighs. Measurement from floor to datum probe at 90 mm mark on left shoulder. Shoulder height derived by subtraction of stool height from this measurement.

## PERCENTILE VALUES

%	mm	in.
1	604.3	23.79
2	609.6	24.00
3	614.3	24.19
5	621.4	24.46
10	630.0	24.80
15	636.7	25.07
20	642.0	25.28
25	647.1	25.48
30	651.1	25.63
35	655.5	25.81
40	659.5	25.97
45	662.6	26.09
50	665.6	26.20
55	668.6	26.32
60	671.2	26.42
65	675.5	26.60
70	679.4	26.75
75	683.2	26.90
80	688.2	27.10
85	693.4	27.30
90	699.0	27.52
95	708.8	27.90
97	714.7	28.14
98	719.0	28.31
99	727.0	28.62

Mean: 665.7 mm; 26.21 in.  
Standard deviation: 26.7 mm; 1.05 in.  
Coefficient of variation: 4.01%  
Range: 577.0 - 754.0 mm; 22.72 - 29.69 in.  
Number of subjects: 2000

Check measure deviation: 8.7 mm; 1.3%

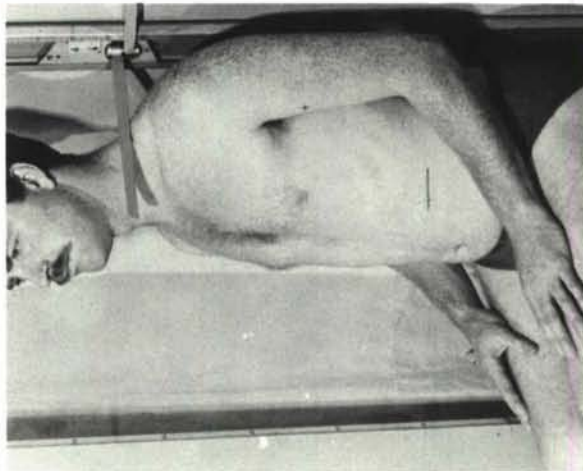


TABLE 8  
ACROMIAL HEIGHT, SITTING

Sitting erect with shoulders relaxed, back clear of rear wall. Elbows held lightly against sides with hands on mid-thighs. Measurement from floor to datum probe at acromial mark. Acromial height derived by subtraction of stool height from this measurement.

PERCENTILE VALUES

%	mm	in.
1	548.5	21.59
2	553.6	21.80
3	557.8	21.96
5	564.4	22.22
10	575.4	22.65
15	581.9	22.91
20	588.4	23.17
25	593.3	23.36
30	597.0	23.51
35	601.2	23.67
40	605.0	23.82
45	608.9	23.97
50	612.3	24.11
55	615.6	24.24
60	619.1	24.38
65	622.4	24.51
70	626.7	24.67
75	631.1	24.85
80	635.5	25.02
85	640.6	25.22
90	647.8	25.50
95	657.8	25.90
97	665.8	26.21
98	669.8	26.37
99	680.5	26.79

Mean: 612.4 mm; 24.11 in.  
Standard deviation: 28.3 mm; 1.11 in.  
Coefficient of variation: 4.62%  
Range: 504.0 - 713.0 mm; 19.84 - 28.07 in.  
Number of subjects: 2000

Check measure deviation: 8.0 mm; 1.3%

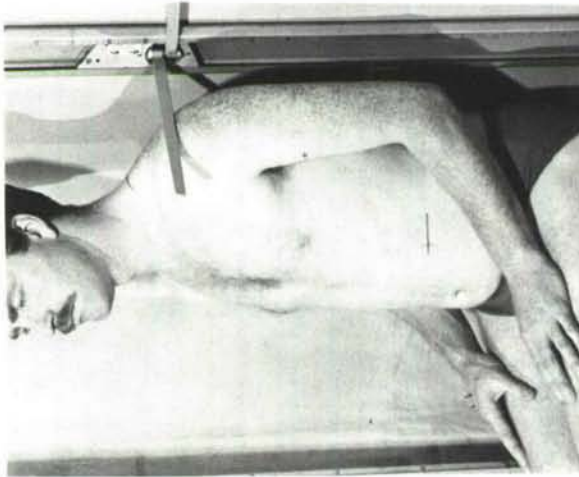


TABLE 9  
ELBOW REST HEIGHT, SITTING

Sitting erect with shoulders relaxed, back clear of rear wall. Elbows held lightly against sides with forearms horizontal. Measurement from floor to datum probe at lower edge of olecranon process. Elbow rest height derived by subtraction of stool height from this measurement.

PERCENTILE VALUES

%	mm	in.
1	188.0	7.40
2	197.4	7.77
3	200.2	7.88
5	206.5	8.13
10	216.5	8.52
15	222.3	8.75
20	226.8	8.93
25	231.3	9.11
30	235.5	9.27
35	238.5	9.39
40	241.7	9.51
45	244.9	9.64
50	248.1	9.77
55	250.7	9.87
60	253.8	9.99
65	256.8	10.11
70	260.0	10.24
75	263.6	10.38
80	268.4	10.57
85	273.1	10.75
90	279.3	11.00
95	287.4	11.32
97	294.3	11.58
98	297.5	11.71
99	305.5	12.03

Mean: 248.1 mm; 9.77 in.  
Standard Deviation: 24.5 mm; 0.97 in.  
Coefficient of Variation: 9.89%  
Range: 164.0 - 323.0 mm; 6.46 - 12.72 in.  
Number of Subjects: 2000

Check measure deviation: 10.2 mm; 4.0%

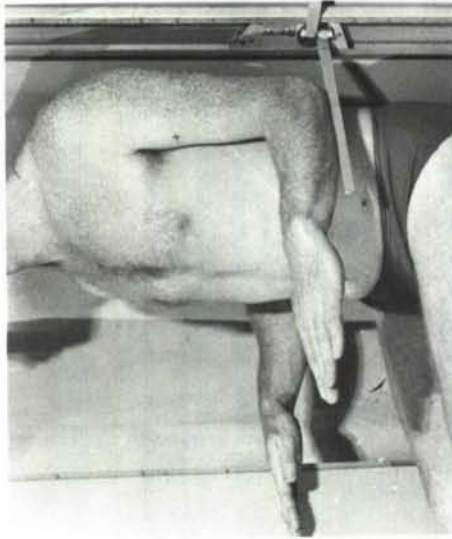




TABLE 10  
BIDELTOID BREADTH

Sitting erect with shoulders relaxed, back clear of rear wall. Elbows held lightly against sides with hands on mid-thighs. Light pressure exerted by right deltoid against perspex panel such that a circle of approximately 30 mm diameter of the skin over the muscle is in contact with the perspex (monitored from mirror). Measurement from end wall to datum probe at maximum prominence of left deltoid muscle.

PERCENTILE VALUES

%	mm	in.
1	418.7	16.49
2	423.5	16.67
3	426.8	16.80
5	431.7	17.00
10	439.3	17.30
15	443.8	17.47
20	447.8	17.63
25	451.4	17.77
30	453.8	17.87
35	457.1	18.00
40	459.6	18.10
45	461.9	18.19
50	464.8	18.30
55	467.5	18.40
60	470.2	18.51
65	473.7	18.65
70	476.3	18.75
75	479.3	18.87
80	482.8	19.01
85	486.7	19.16
90	491.9	19.37
95	499.7	19.67
97	505.4	19.90
98	509.8	20.07
99	513.7	20.22

Mean: 465.8 mm; 18.34 in.  
Standard deviation: 20.8 mm; 0.82 in.  
Coefficient of variation: 4.47%  
Range: 396.0 - 547.0 mm; 15.59 - 21.54 in.  
Number of subjects: 1993  
Check measure deviation: 6.6 mm; 1.4%



TABLE 11  
STOOL HEIGHT

Measurement from floor to datum probe at stool sitting surface. The stool is retained at the height initially set for the subject for all sitting measurements.

PERCENTILE VALUES

%	mm	in.
1	366.3	14.42
2	371.6	14.63
3	376.3	14.82
5	382.6	15.06
10	391.6	15.42
15	398.9	15.71
20	402.6	15.85
25	407.2	16.03
30	410.4	16.16
35	414.2	16.31
40	417.4	16.43
45	420.0	16.54
50	423.3	16.66
55	427.1	16.81
60	429.9	16.92
65	433.2	17.06
70	436.5	17.19
75	439.9	17.32
80	444.2	17.49
85	449.2	17.68
90	456.2	17.96
95	466.8	18.38
97	469.0	18.46
98	469.9	18.50
99	470.9	18.54

Mean: 423.9 mm; 16.69 in.  
Standard deviation: 24.3 mm; 0.96 in.  
Coefficient of variation: 5.74%  
Range: 333.0 - 473.0 mm; 13.11 - 18.62 in.  
Number of subjects: 2000

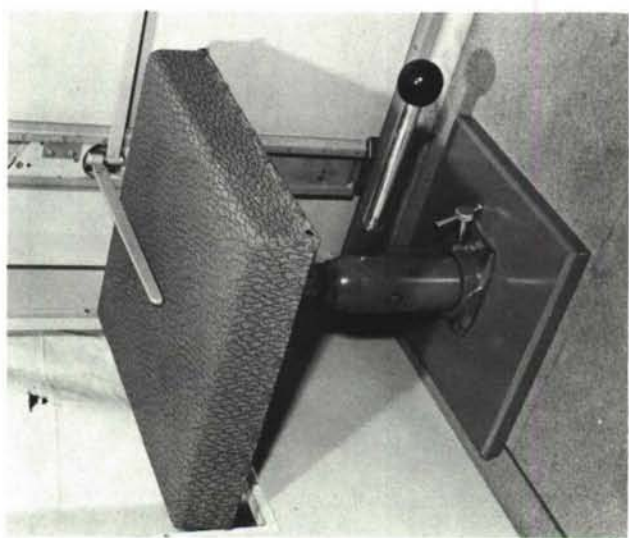


TABLE 12

BIACROMIAL BREADTH

Sitting erect with shoulders relaxed, elbows held lightly against sides with hands on mid-thighs. Measurement with datum faces of caliper in firm contact with outer edges of acromial processes.

PERCENTILE VALUES

%	mm	in.
1	359.0	14.13
2	366.4	14.43
3	369.7	14.55
5	374.4	14.74
10	381.9	15.03
15	386.8	15.23
20	391.1	15.40
25	393.9	15.51
30	396.8	15.62
35	399.6	15.73
40	402.5	15.84
45	405.3	15.96
50	407.7	16.05
55	409.8	16.13
60	412.0	16.22
65	414.5	16.32
70	417.2	16.42
75	420.3	16.55
80	423.0	16.65
85	426.4	16.79
90	430.4	16.94
95	437.5	17.22
97	442.1	17.41
98	445.1	17.53
99	451.5	17.78

Mean: 407.3 mm; 16.04 in.  
Standard deviation: 19.2 mm; 0.76 in.  
Coefficient of variation: 4.72%  
Range: 342.0 - 486.0 mm; 13.46 - 19.13 in.  
Number of subjects: 2000

Check measure deviation: 11.2 mm; 2.7%



TABLE 13

HIP BREADTH, SITTING

Sitting erect with knees together. Measurement with datum faces of caliper in light contact with buttocks at widest point.

PERCENTILE VALUES

%	mm	in.
1	323.7	12.74
2	328.3	12.93
3	332.1	13.08
5	337.1	13.27
10	343.5	13.52
15	348.0	13.70
20	351.4	13.83
25	354.3	13.95
30	356.8	14.05
35	359.5	14.15
40	362.5	14.27
45	364.8	14.36
50	367.0	14.45
55	369.6	14.55
60	371.8	14.64
65	374.5	14.74
70	377.6	14.87
75	381.3	15.01
80	383.9	15.11
85	388.1	15.28
90	393.2	15.48
95	400.3	15.76
97	406.1	15.99
98	409.5	16.12
99	414.7	16.33

Mean: 368.3 mm; 14.50 in.  
Standard deviation: 19.5 mm; 0.77 in.  
Coefficient of variation: 5.29%  
Range: 310.0 - 436.0 mm; 12.20 - 17.17 in.  
Number of subjects: 2000

Check measure deviation: 1.9 mm; 0.5%



TABLE 14

CERVICALE HEIGHT

Standing erect head forward facing. Measurement from floor to datum probe at level of cervicale mark.

PERCENTILE VALUES

%	mm	in.
1	1391.5	54.78
2	1405.0	55.31
3	1410.0	55.51
5	1420.5	55.92
10	1439.8	56.69
15	1453.9	57.24
20	1467.0	57.75
25	1476.6	58.14
30	1486.2	58.51
35	1495.7	58.89
40	1502.8	59.17
45	1509.9	59.44
50	1516.9	59.72
55	1523.1	59.97
60	1531.1	60.28
65	1539.3	60.60
70	1546.7	60.89
75	1555.2	61.23
80	1563.8	61.57
85	1575.2	62.02
90	1590.4	62.61
95	1613.8	63.54
97	1631.2	64.22
98	1639.8	64.56
99	1661.0	65.39

Mean: 1517.2 mm; 59.73 in.  
Standard deviation: 58.5 mm; 2.30 in.  
Coefficient of variation: 3.85%  
Range: 1285.0 - 1749.0 mm; 50.59 - 68.86 in.  
Number of subjects: 1999

Check measure deviation: 6.6 mm; 0.4%

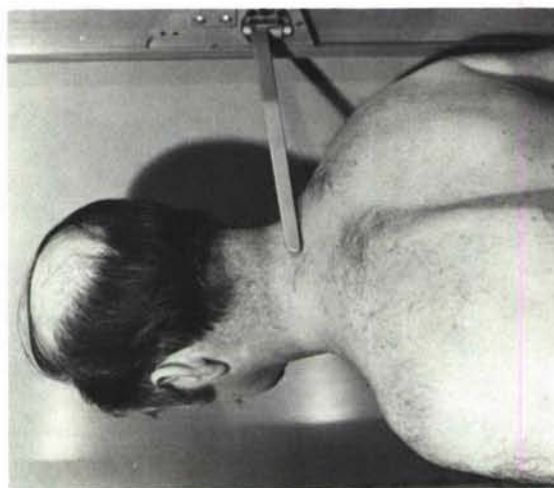


TABLE 15

STATURE

Standing erect head forward facing. Measurement from floor to datum probe at vertex.

PERCENTILE VALUES

%	mm	in.
1	1638.0	64.49
2	1651.6	65.02
3	1660.5	65.37
5	1672.7	65.85
10	1693.7	66.68
15	1708.6	67.27
20	1721.1	67.76
25	1732.4	68.20
30	1741.3	68.56
35	1750.8	68.93
40	1758.4	69.23
45	1766.0	69.53
50	1774.8	69.87
55	1781.6	70.14
60	1789.2	70.44
65	1796.4	70.72
70	1805.6	71.09
75	1814.2	71.43
80	1824.4	71.83
85	1838.3	72.37
90	1854.3	73.01
95	1879.3	73.99
97	1892.8	74.52
98	1905.0	75.00
99	1924.0	75.75

Mean: 1774.4 mm; 69.86 in.  
Standard deviation: 62.3 mm; 2.45 in.  
Coefficient of variation: 3.51%  
Range: 1514.0 - 2009.0 mm; 59.61 - 79.09 in.  
Number of subjects: 2000

Check measure deviation: 2.3 mm; 0.1%

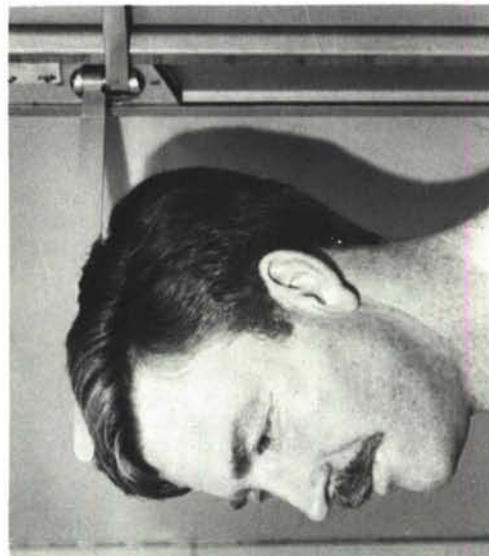




TABLE 16  
AXILLA HEIGHT

Standing erect. Datum probe placed firmly in left axilla lifting shoulder. Shoulders then readjusted to their natural level. Measurement from floor to datum probe.

PERCENTILE VALUES

%	mm	in.
1	1218.0	47.95
2	1229.5	48.41
3	1237.9	48.73
5	1247.8	49.12
10	1267.0	49.88
15	1281.9	50.47
20	1292.1	50.87
25	1299.9	51.18
30	1311.5	51.63
35	1319.4	51.95
40	1326.4	52.22
45	1333.3	52.49
50	1339.7	52.75
55	1346.1	53.00
60	1351.9	53.23
65	1358.5	53.48
70	1365.3	53.75
75	1373.3	54.07
80	1384.1	54.49
85	1396.3	54.97
90	1409.2	55.48
95	1427.8	56.21
97	1441.5	56.75
98	1457.0	57.36
99	1478.0	58.19

Mean: 1339.4 mm; 52.73 in.  
Standard deviation: 55.0 mm; 2.17 in.  
Coefficient of variation: 4.11%  
Range: 1121.0 - 1543.0 mm; 44.13 - 60.75 in.  
Number of subjects: 2000  
Check measure deviation: 14.7 mm; 1.1%

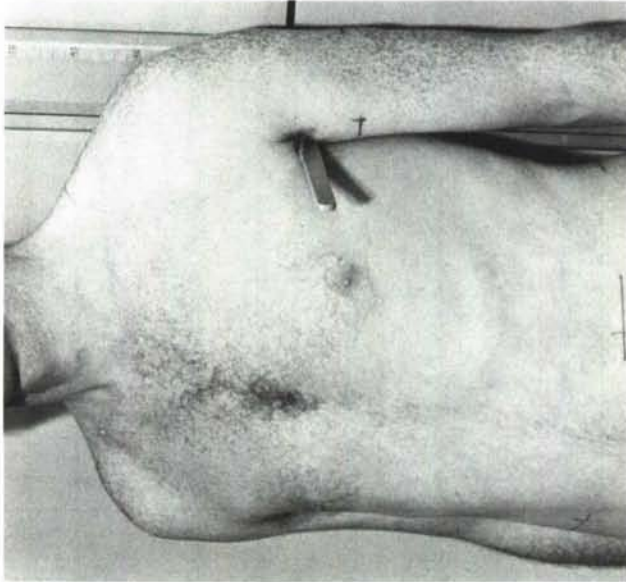


TABLE 17  
WAIST HEIGHT SERIAL NOS. 1-1662

NB Waist located by subject at the preferred height of the waist adjustment tabs on a flying coverall  
Standing erect with shoulders relaxed, arms by sides. Measurement from floor to datum probe at level of left waist mark.

PERCENTILE VALUES

%	mm	in.
1	957.0	37.68
2	970.0	38.19
3	979.5	38.56
5	990.5	39.00
10	1010.0	39.76
15	1020.8	40.19
20	1030.8	40.58
25	1039.7	40.93
30	1046.3	41.19
35	1053.7	41.48
40	1059.2	41.70
45	1065.7	41.96
50	1072.5	42.22
55	1079.7	42.51
60	1085.7	42.74
65	1091.9	42.99
70	1099.8	43.30
75	1107.1	43.59
80	1114.1	43.86
85	1124.3	44.26
90	1137.4	44.78
95	1157.4	45.56
97	1177.5	46.36
98	1190.0	46.85
99	1199.8	47.24

Mean: 1074.0 mm; 42.28 in.  
Standard deviation: 51.4 mm; 2.02 in.  
Coefficient of variation: 4.78%  
Range: 884.0 - 1302.0 mm; 34.80 - 51.26 in.  
Number of subjects: 1652

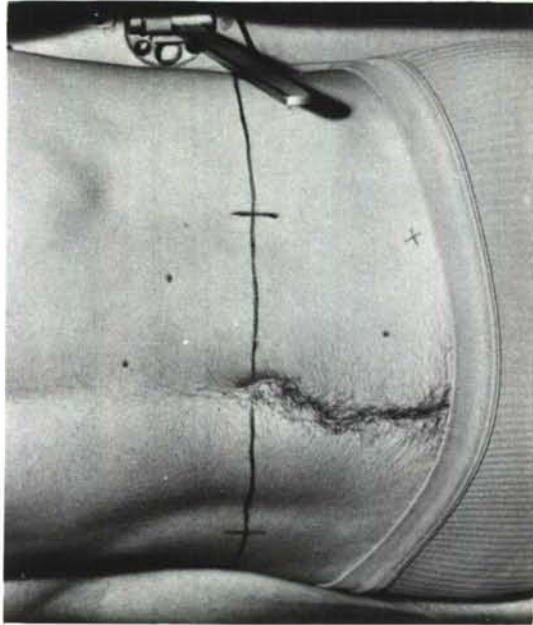


TABLE 18

WAIST HEIGHT SERIAL NOS. 1663-2013

NB Waist located at natural waist intent

Standing erect with shoulders relaxed, arms by sides. Measurement from floor to datum probe at level of left waist mark.

PERCENTILE VALUES

%	mm	in.
1	1009.2	39.73
2	1017.8	40.07
3	1023.4	40.29
5	1034.4	40.72
10	1053.2	41.46
15	1064.6	41.91
20	1075.5	42.34
25	1082.8	42.63
30	1090.8	42.94
35	1097.3	43.20
40	1104.4	43.48
45	1110.7	43.73
50	1116.7	43.96
55	1121.5	44.15
60	1128.3	44.42
65	1135.4	44.70
70	1143.3	45.01
75	1152.0	45.35
80	1156.3	45.53
85	1162.3	45.76
90	1175.8	46.29
95	1194.2	47.02
97	1205.6	47.46
98	1210.1	47.64
99	1226.8	48.30

Mean: 1116.6 mm; 43.96 in.  
Standard deviation: 48.2 mm; 1.90 in.  
Coefficient of variation: 4.32%  
Range: 973.0 - 1288.0 mm; 38.31 - 50.71 in.  
Number of subjects: 348

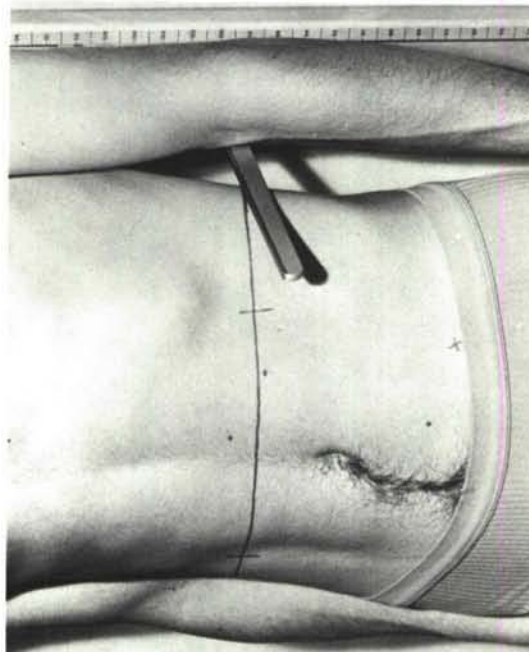


TABLE 19

FINGERTIP HEIGHT

Standing erect with shoulders relaxed, arms and fingers stretched at sides. Measurement from floor to datum probe at tip of longest finger of left hand.

PERCENTILE VALUES

%	mm	in.
1	590.5	23.25
2	600.0	23.62
3	606.0	23.86
5	614.6	24.19
10	625.1	24.61
15	632.9	24.92
20	641.5	25.26
25	647.7	25.50
30	653.0	25.71
35	657.6	25.89
40	661.9	26.06
45	665.8	26.21
50	670.0	26.38
55	674.7	26.56
60	678.7	26.72
65	683.3	26.90
70	687.8	27.08
75	693.1	27.29
80	698.7	27.51
85	705.2	27.76
90	714.4	28.13
95	727.2	28.63
97	734.2	28.91
98	737.8	29.05
99	749.0	29.49

Mean: 670.7 mm; 26.40 in.  
Standard deviation: 34.4 mm; 1.35 in.  
Coefficient of variation: 5.12%  
Range: 558.0 - 790.0 mm; 21.97 - 31.10 in.  
Number of subjects: 1999

Check measure deviation: 7.3 mm; 1.1%

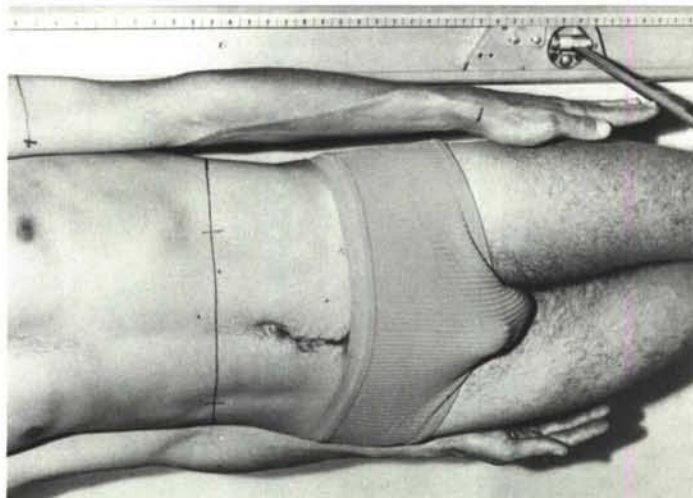
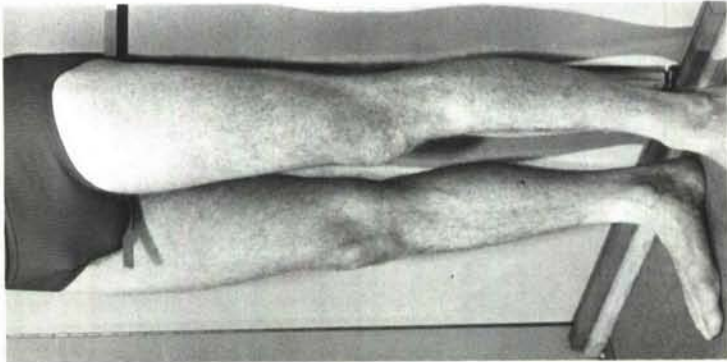


TABLE 20  
CROTCH HEIGHT

Standing erect, back to rear wall, feet approximately 150 mm apart. Datum probe placed firmly into perineum without accommodating upper thigh, buttocks or genitals. Measurement from floor to datum probe.



PERCENTILE VALUES

%	mm	in.
1	758.0	29.84
2	769.0	30.28
3	775.3	30.52
5	785.0	30.91
10	798.6	31.44
15	807.7	31.80
20	817.5	32.19
25	823.7	32.43
30	830.5	32.70
35	836.1	32.92
40	842.5	33.17
45	847.3	33.36
50	853.4	33.60
55	857.9	33.78
60	862.9	33.97
65	868.4	34.19
70	873.7	34.40
75	880.3	34.66
80	888.0	34.96
85	896.1	35.28
90	906.2	35.68
95	926.8	36.49
97	936.2	36.86
98	948.0	37.32
99	960.0	37.80

Mean: 853.5 mm; 33.60 in.  
Standard Deviation: 43.0 mm; 1.69 in.  
Coefficient of Variation: 5.04%  
Range: 700.0 - 1011.0 mm; 27.56 - 39.80 in.  
Number of Subjects: 2000

Check measure deviation: 2.8 mm; 0.3%

TABLE 21  
SPAN

Standing erect, back to rear wall. Arms and hands stretched laterally and horizontally to maximum extent with tip of longest finger of right hand touching end wall. Measurement from end wall to datum probe at tip of longest finger of left hand.



PERCENTILE VALUES

%	mm	in.
1	1665.0	65.55
2	1677.5	66.04
3	1691.9	66.61
5	1711.8	67.39
10	1734.4	68.28
15	1751.5	68.96
20	1763.7	69.44
25	1777.2	69.97
30	1788.6	70.42
35	1799.5	70.84
40	1809.2	71.23
45	1817.8	71.57
50	1826.4	71.90
55	1835.3	72.26
60	1843.9	72.59
65	1853.8	72.99
70	1866.0	73.46
75	1876.6	73.88
80	1887.9	74.33
85	1901.4	74.86
90	1919.8	75.58
95	1948.4	76.71
97	1965.0	77.36
98	1977.0	77.84
99	2014.0	79.29

Mean: 1828.0 mm; 71.97 in.  
Standard Deviation: 73.4 mm; 2.89 in.  
Coefficient of Variation: 4.01%  
Range: 1494.0 - 2096.0 mm; 58.82 - 82.52 in.  
Number of Subjects: 1998

Check measure deviation: 7.0 mm; 0.4%



TABLE 22

INTER-ELBOW SPAN

Standing erect, back to rear wall. Upper arms stretched laterally and horizontally to maximum extent with forearms flexed at 90° in horizontal plane, right elbow touching end wall. Measurement from end wall to datum probe at left elbow.



PERCENTILE VALUES

%	mm	in.
1	893.5	35.18
2	901.2	35.48
3	909.0	35.79
5	917.5	36.12
10	936.2	36.86
15	947.0	37.28
20	955.2	37.61
25	961.3	37.85
30	967.3	38.08
35	972.8	38.30
40	979.4	38.56
45	985.0	38.78
50	989.9	38.97
55	995.3	39.18
60	1001.2	39.42
65	1006.6	39.63
70	1012.4	39.86
75	1019.7	40.15
80	1026.2	40.40
85	1034.7	40.74
90	1043.5	41.08
95	1058.4	41.67
97	1070.2	42.13
98	1075.8	42.35
99	1087.5	42.82

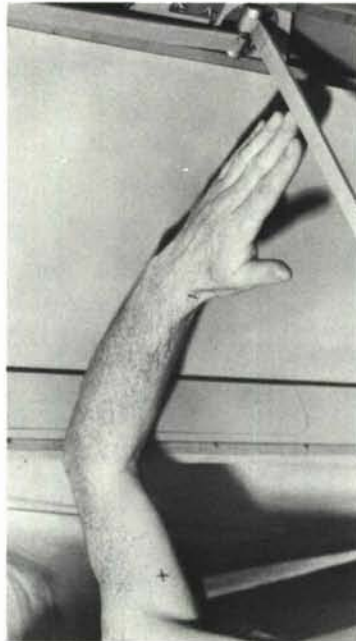
Mean: 990.6 mm; 39.00 in.  
Standard Deviation: 42.6 mm; 1.68 in.  
Coefficient of Variation: 4.30%  
Range: 790.0 - 1152.0 mm; 31.10 - 45.35 in.  
Number of Subjects: 1999

Check Measure Deviation: 3.8 mm; 0.4%

TABLE 23

ELBOW-FINGERTIP LENGTH

Standing erect, back to end wall. Left upper arm horizontal with elbow touching end wall. Left forearm horizontal and parallel to rear wall with hand and fingers outstretched in line with forearm. Measurement from end wall to datum probe at tip of longest finger of left hand.



PERCENTILE VALUES

%	mm	in.
1	431.8	17.00
2	437.7	17.23
3	441.7	17.39
5	446.8	17.59
10	453.7	17.86
15	459.1	18.08
20	462.7	18.21
25	465.9	18.34
30	468.6	18.45
35	471.3	18.55
40	473.7	18.65
45	476.2	18.75
50	478.9	18.85
55	481.5	18.96
60	483.7	19.04
65	486.3	19.15
70	488.8	19.25
75	492.0	19.37
80	495.7	19.51
85	499.7	19.67
90	504.9	19.88
95	513.9	20.23
97	520.2	20.48
98	523.7	20.62
99	531.0	20.91

Mean: 479.8 mm; 18.89 in.  
Standard Deviation: 20.4 mm; 0.80 in.  
Coefficient of Variation: 4.25%  
Range: 401.0 - 568.0 mm; 15.79 - 22.36 in.  
Number of Subjects: 1999

Check measure deviation: 3.1 mm; 0.6%

TABLE 24  
ELBOW-WRIST LENGTH

Standing erect, elbow touching end wall. Left forearm horizontal, parallel to rear wall and rotated so that back of hand faces rear wall with wrist mark uppermost. Measurement from end wall to datum probe at wrist mark.

PERCENTILE VALUES		
%	mm	in.
1	254.3	10.01
2	258.6	10.18
3	261.2	10.28
5	264.7	10.42
10	270.4	10.64
15	273.4	10.76
20	275.8	10.86
25	278.3	10.96
30	280.2	11.03
35	282.6	11.13
40	284.5	11.20
45	285.9	11.26
50	287.8	11.33
55	289.4	11.39
60	291.2	11.46
65	293.1	11.54
70	294.8	11.61
75	297.0	11.69
80	299.3	11.78
85	302.6	11.91
90	305.9	12.04
95	311.6	12.27
97	315.8	12.43
98	317.9	12.51
99	323.3	12.73

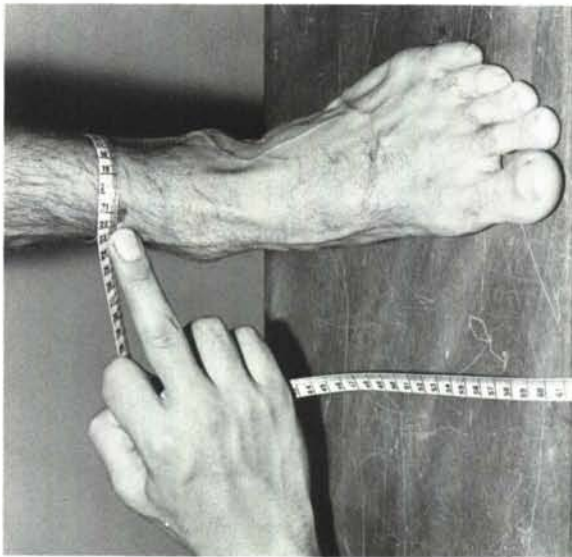


Mean: 288.4 mm; 11.35 in.  
Standard Deviation: 14.2 mm; 0.56 in.  
Coefficient of Variation: 4.93%  
Range: 244.0 - 346.0 mm; 9.61 - 13.62 in.  
Number of Subjects: 1998  
Check measure deviation: 7.2 mm; 2.5%

TABLE 25  
ANKLE CIRCUMFERENCE

Standing erect. Measurement with tape passing horizontally around minimum circumference of left ankle above malleoli.

PERCENTILE VALUES		
%	mm	in.
1	197.5	7.78
2	201.2	7.92
3	203.2	8.00
5	205.6	8.09
10	209.1	8.23
15	211.9	8.34
20	214.3	8.44
25	215.9	8.50
30	218.2	8.59
35	219.6	8.64
40	221.2	8.71
45	222.9	8.78
50	224.3	8.83
55	225.7	8.89
60	227.4	8.95
65	228.9	9.01
70	230.3	9.07
75	232.8	9.16
80	234.7	9.24
85	237.5	9.35
90	240.3	9.46
95	245.6	9.67
97	249.5	9.82
98	251.0	9.88
99	254.9	10.04



Mean: 225.2 mm; 8.86 in.  
Standard deviation: 12.2 mm; 0.48 in.  
Coefficient of variation: 5.43%  
Range: 185.0 - 270.0 mm; 7.28 - 10.63 in.  
Number of subjects: 1999  
Check measure deviation: 3.3 mm; 1.4%

TABLE 26

CALF CIRCUMFERENCE

Standing erect. Measurement with tape passing horizontally around maximum circumference of left calf.

PERCENTILE VALUES

%	mm	in.
1	319.0	12.56
2	323.4	12.73
3	327.3	12.88
5	331.5	13.05
10	338.5	13.33
15	343.7	13.53
20	347.7	13.69
25	351.5	13.84
30	354.8	13.97
35	357.4	14.07
40	360.0	14.17
45	362.8	14.28
50	365.3	14.38
55	368.1	14.49
60	370.7	14.60
65	374.4	14.74
70	377.0	14.84
75	380.4	14.98
80	384.6	15.14
85	389.3	15.33
90	394.7	15.54
95	402.6	15.85
97	407.7	16.05
98	410.7	16.17
99	416.3	16.39

Mean: 366.6 mm; 14.43 in.  
Standard deviation 21.5 mm; 0.85 in.  
Coefficient of variation: 5.86%  
Range: 300.0 - 440.0 mm; 11.81 - 17.32 in.  
Number of subjects: 2000

Check measure deviation: 2.0 mm; 0.5%

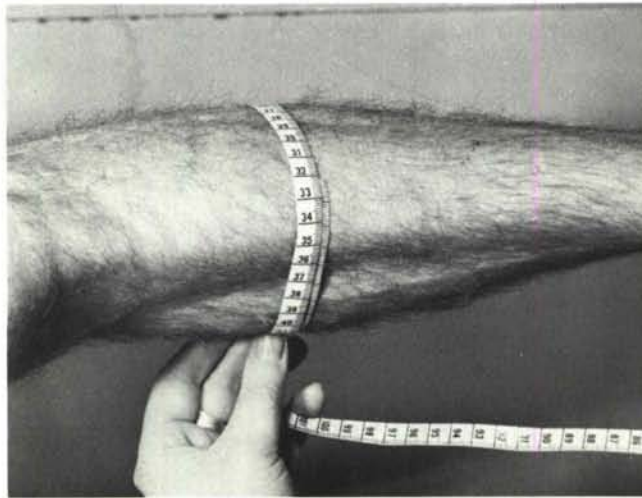


TABLE 27

THIGH CIRCUMFERENCE

Standing erect. Measurement with the tape passing horizontally around left thigh immediately below gluteal fold.

PERCENTILE VALUES

%	mm	in.
1	480.0	18.90
2	488.5	19.23
3	496.0	19.53
5	507.0	19.96
10	519.1	20.44
15	528.8	20.82
20	536.6	21.13
25	543.1	21.38
30	549.3	21.63
35	554.1	21.82
40	559.8	22.04
45	564.6	22.23
50	569.7	22.43
55	575.1	22.64
60	579.7	22.82
65	584.9	23.03
70	589.8	23.22
75	595.8	23.46
80	601.9	23.70
85	609.2	23.98
90	617.1	24.30
95	634.2	24.97
97	642.0	25.28
98	646.6	25.46
99	658.7	25.93

Mean: 569.8 mm; 22.43 in.  
Standard deviation: 38.7 mm; 1.52 in.  
Coefficient of variation: 6.79%  
Range: 447.0 - 701.0 mm; 17.60 - 27.60 in.  
Number of subjects: 2000

Check measure deviation: 3.7 mm; 0.6%

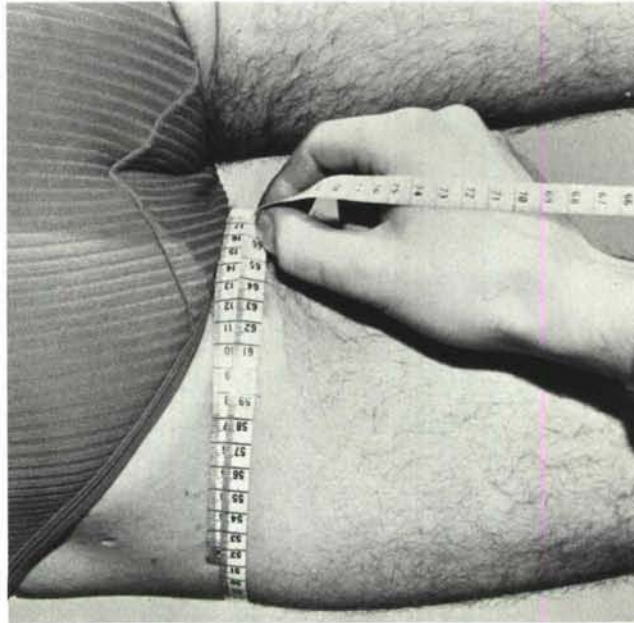




TABLE 28  
BUTTOCK CIRCUMFERENCE

Standing erect. Measurement with tape passing horizontally around maximum protuberance of buttocks (care taken not to include lower edge seam of briefs).

PERCENTILE VALUES

%	mm	in.
1	873.3	34.38
2	884.7	34.83
3	894.7	35.22
5	905.8	35.66
10	926.3	36.47
15	937.4	36.91
20	947.2	37.29
25	955.6	37.62
30	961.7	37.86
35	967.6	38.09
40	974.4	38.36
45	981.6	38.65
50	988.5	38.92
55	995.1	39.18
60	1001.6	39.43
65	1008.1	39.69
70	1014.6	39.94
75	1021.4	40.21
80	1030.0	40.55
85	1040.2	40.95
90	1053.4	41.47
95	1073.0	42.24
97	1085.0	42.72
98	1094.8	43.10
99	1108.0	43.62

Mean: 989.3 mm; 38.95 in.  
Standard deviation: 50.1mm; 1.97 in.  
Coefficient of variation: 5.06%  
Range: 813.0 - 1183.0 mm; 32.01 - 46.57 in.  
Number of subjects: 1999

Check measure deviation: 7.5 mm; 0.8%

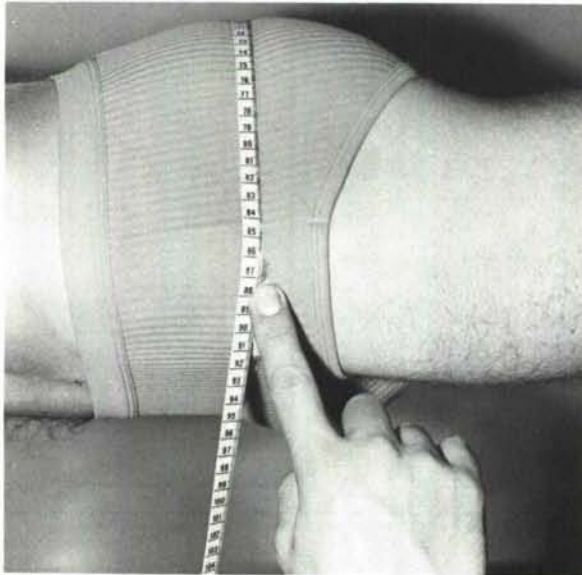


TABLE 29  
WAIST CIRCUMFERENCE SERIAL NOS. 1-1662

NB Waist located by subject at the preferred height of the waist adjustment tabs on a flying coverall

Standing erect. Measurement with tape passing horizontally around waist, lower edge of tape being aligned with waist marks.

PERCENTILE VALUES

%	mm	in.
1	707.5	27.86
2	728.0	28.66
3	735.3	28.95
5	744.6	29.31
10	769.0	30.28
15	783.3	30.84
20	795.6	31.32
25	804.7	31.68
30	815.1	32.09
35	827.7	32.59
40	837.0	32.95
45	844.9	33.27
50	853.5	33.60
55	863.6	34.00
60	873.9	34.41
65	882.0	34.72
70	893.4	35.17
75	905.0	35.63
80	917.1	36.11
85	930.2	36.62
90	947.8	37.31
95	977.6	38.49
97	995.2	39.18
98	1005.5	39.59
99	1019.9	40.15

Mean: 857.3 mm; 33.75 in.  
Standard deviation: 70.0 mm; 2.76 in.  
Coefficient of variation: 8.17%  
Range: 668.0 - 1120.0 mm; 26.30 - 44.09 in.  
Number of subjects: 1652

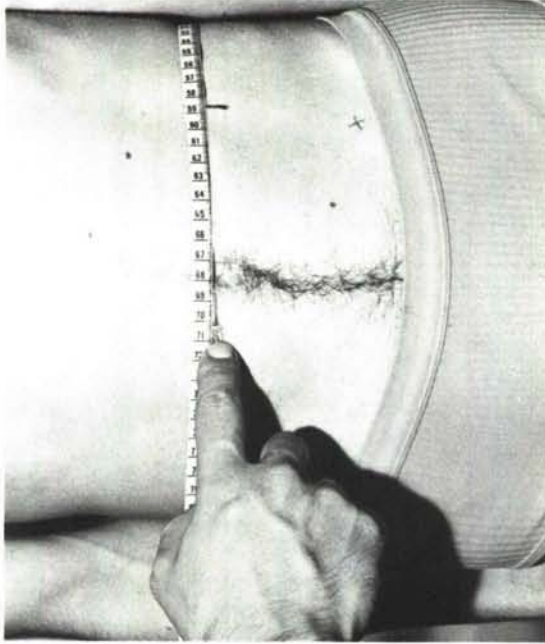


TABLE 30

WAIST CIRCUMFERENCE SERIAL NOS. 1663-2013

NB Waist located at natural waist indent

Standing erect. Measurement with tape passing horizontally around waist, lower edge of tape being aligned with waist marks.

PERCENTILE VALUES

%	mm	in.
1	692.8	27.27
2	711.0	27.99
3	719.9	28.34
5	728.7	28.69
10	748.6	29.47
15	762.1	30.01
20	775.5	30.53
25	785.5	30.93
30	794.7	31.29
35	803.4	31.63
40	810.7	31.92
45	818.5	32.23
50	823.5	32.42
55	832.2	32.76
60	837.8	32.98
65	845.8	33.30
70	857.3	33.75
75	865.5	34.07
80	877.1	34.53
85	889.5	35.02
90	907.5	35.73
95	955.6	37.62
97	973.9	38.34
98	1001.0	39.41
99	1010.7	39.79

Mean: 829.3 mm; 32.65 in.  
Standard deviation: 64.6 mm; 2.54 in.  
Coefficient of variation: 7.79%  
Range: 660.0 - 1033.0 mm; 25.98 - 40.67 in.  
Number of subjects: 348

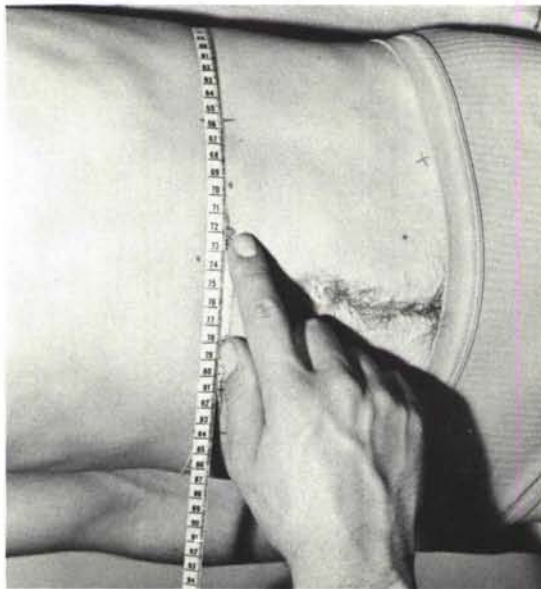


TABLE 31

CHEST CIRCUMFERENCE

Standing erect, back to mirror in rear wall. Tape placed horizontally around chest at nipple level with arms raised. Shoulders then relaxed and alignment of tape at back checked in mirror image. Measurement during quiet breathing, the mean being recorded.

PERCENTILE VALUES

%	mm	in.
1	845.5	33.29
2	861.7	33.93
3	869.6	34.24
5	883.0	34.76
10	901.4	35.49
15	913.8	35.97
20	923.7	36.37
25	931.7	36.68
30	939.0	36.97
35	947.2	37.29
40	954.3	37.57
45	959.9	37.79
50	967.2	38.08
55	974.3	38.36
60	982.4	38.68
65	990.2	38.98
70	999.2	39.34
75	1008.0	39.69
80	1018.3	40.09
85	1031.0	40.59
90	1047.7	41.25
95	1070.0	42.13
97	1087.0	42.80
98	1096.7	43.18
99	1110.5	43.72

Mean: 971.7 mm; 38.26 in.  
Standard deviation: 57.0 mm; 2.25 in.  
Coefficient of variation: 5.87%  
Range: 822.0 - 1245.0 mm; 32.36 - 49.02 in.  
Number of subjects: 1999

Check measure deviation: 11.5 mm; 1.2%

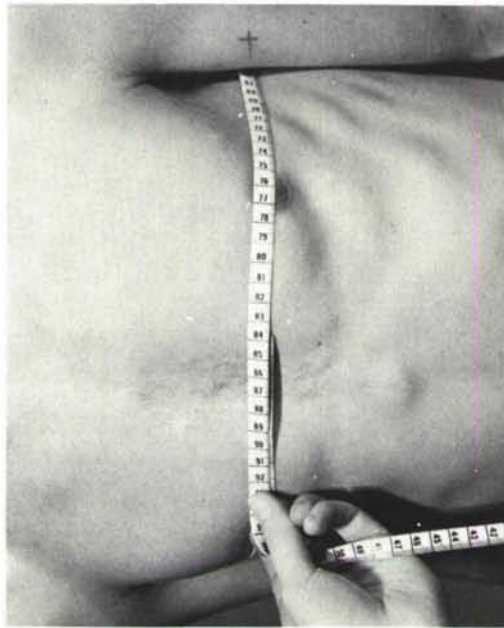




TABLE 32  
NECK CIRCUMFERENCE

Standing erect, head forward facing. Measurement with tape passing around neck giving circumference perpendicular to axis of neck immediately below larynx.

PERCENTILE VALUES

%	mm	in.
1	343.0	13.50
2	348.8	13.73
3	351.1	13.82
5	354.6	13.96
10	359.9	14.17
15	363.4	14.31
20	366.4	14.43
25	369.2	14.53
30	371.5	14.63
35	373.8	14.72
40	376.0	14.81
45	378.4	14.90
50	380.1	14.96
55	382.4	15.06
60	384.7	15.15
65	387.2	15.24
70	389.7	15.34
75	392.3	15.45
80	394.7	15.54
85	398.1	15.67
90	403.2	15.87
95	409.7	16.13
97	414.2	16.31
98	416.6	16.40
99	420.8	16.57

Mean: 381.5 mm; 15.02 in.  
Standard deviation: 16.9 mm; 0.66 in.  
Coefficient of variation: 4.42%  
Range: 332.0 - 448.0 mm; 13.07 - 17.64 in.  
Number of subjects: 2000

Check measure deviation: 4.1 mm; 1.1%

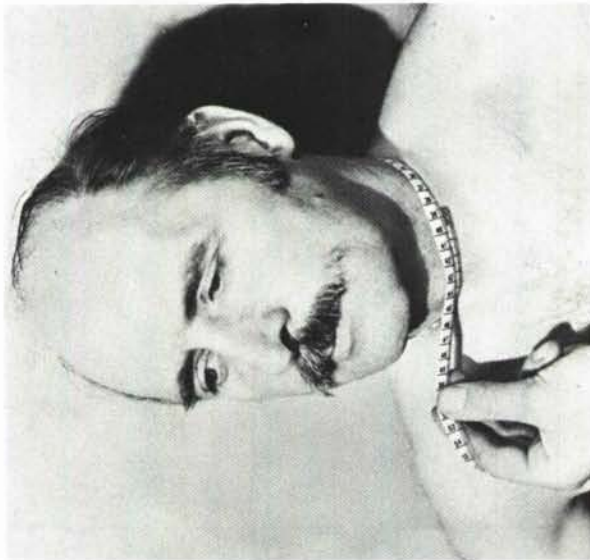


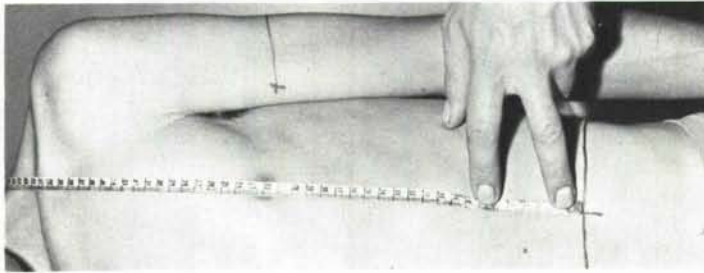
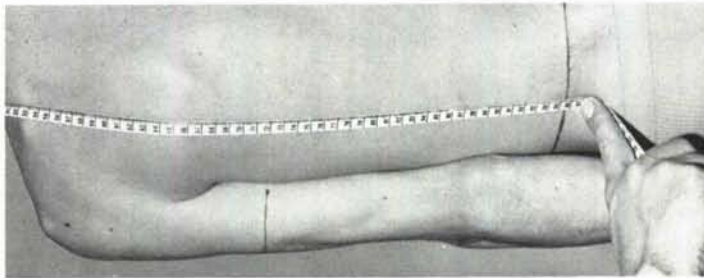
TABLE 33  
WAIST TO WAIST OVER SHOULDER SERIAL NOS. 1-1662

NB Waist located by subject at the preferred height of the waist adjustment tabs on a flying coverall Standing erect with shoulders relaxed, arms by sides. Measurement with tape passing vertically from 90 mm waist line mark at front, over left shoulder at the 90 mm shoulder mark and vertically down to 90 mm waist line mark at back, tape spanning any body hollows.

PERCENTILE VALUES

%	mm	in.
1	866.5	34.11
2	881.0	34.69
3	889.5	35.02
5	899.4	35.41
10	916.4	36.08
15	929.2	36.58
20	938.4	36.94
25	946.5	37.26
30	954.2	37.57
35	961.1	37.84
40	968.5	38.13
45	974.2	38.35
50	982.3	38.67
55	989.2	38.95
60	995.9	39.21
65	1003.2	39.49
70	1011.5	39.82
75	1019.7	40.15
80	1030.1	40.56
85	1042.3	41.04
90	1055.8	41.57
95	1075.8	42.35
97	1088.1	42.84
98	1094.5	43.09
99	1110.7	43.73

Mean: 984.6 mm; 38.76 in.  
Standard deviation: 53.7 mm; 2.11 in.  
Coefficient of variation: 5.45%  
Range: 827.0 - 1177.0 mm; 32.56 - 46.34 in.  
Number of subjects: 1652



Back

Front

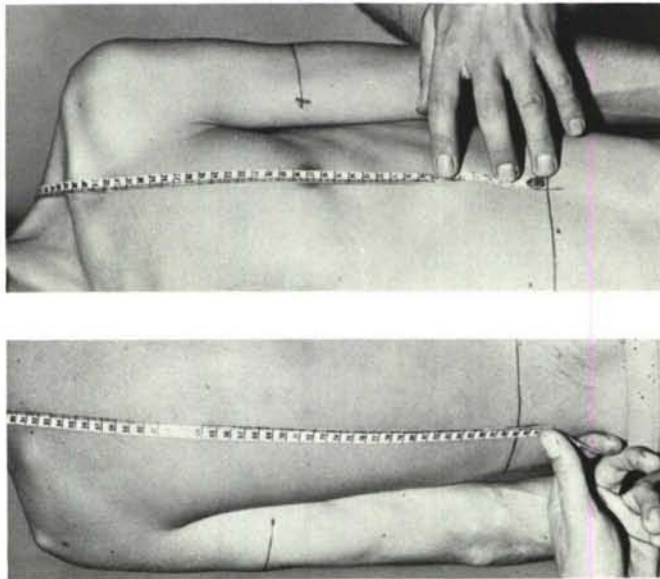


TABLE 34

WAIST TO WAIST OVER SHOULDER SERIAL NOS. 1663-2013

NB Waist located at natural waist indent

Standing erect with shoulders relaxed, arms by sides. Measurement with tape passing vertically from 90 mm waist line mark at front, over left shoulder at the 90 mm shoulder mark and vertically down to 90 mm waist line mark at back, tape spanning any body hollows.



PERCENTILE VALUES		
%	mm	in.
1	791.5	31.16
2	810.9	31.93
3	817.4	32.18
5	830.2	32.68
10	840.5	33.09
15	849.5	33.45
20	859.5	33.84
25	865.9	34.09
30	872.0	34.33
35	878.1	34.57
40	885.2	34.85
45	889.9	35.03
50	894.6	35.22
55	900.0	35.43
60	904.4	35.61
65	908.3	35.76
70	917.4	36.12
75	921.7	36.29
80	929.1	36.58
85	936.4	36.87
90	947.7	37.31
95	959.6	37.78
97	967.3	38.08
98	970.2	38.20
99	982.1	38.67

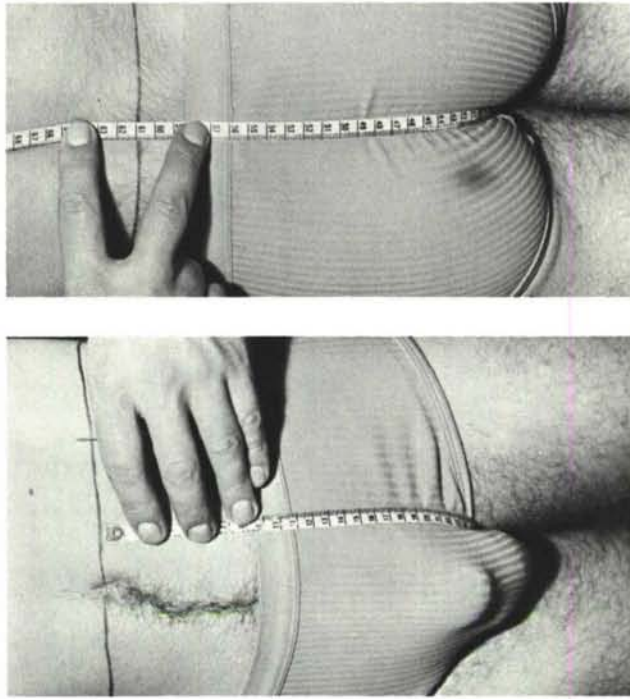
Mean: 894.7 mm; 35.23 in.  
Standard deviation: 41.2 mm; 1 62 in.  
Coefficient of variation: 4.61%  
Range: 763.0 - 1065.0 mm; 30.04 - 41.93 in.  
Number of subjects: 347

TABLE 35

CROTCH LENGTH SERIAL NOS 1-1662

NB Waist located by subject at the preferred height of the waist adjustment tabs on a flying coverall

Standing erect. Measurement with tape passing vertically down from waist line through crotch to left of genitals and vertically up between buttocks to mid-line waist mark at back.



PERCENTILE VALUES		
%	mm	in.
1	517.5	20.37
2	534.5	21.04
3	546.1	21.50
5	558.0	21.97
10	575.2	22.65
15	587.6	23.14
20	597.0	23.51
25	603.4	23.76
30	610.1	24.02
35	618.2	24.34
40	625.5	24.63
45	632.2	24.89
50	639.0	25.16
55	644.9	25.39
60	652.5	25.69
75	659.6	25.97
70	669.2	26.35
75	676.8	26.64
80	686.8	27.04
85	697.2	27.45
90	709.6	27.94
95	729.7	28.73
97	742.7	29.24
98	750.0	29.53
99	765.8	30.15

Mean: 641.3 mm; 25.25 in.  
Standard deviation: 53.2 mm; 2.10 in.  
Coefficient of variation: 8.30%  
Range: 461.0 - 885.0 mm; 18.15 - 34.84 in.  
Number of subjects: 1652

TABLE 36

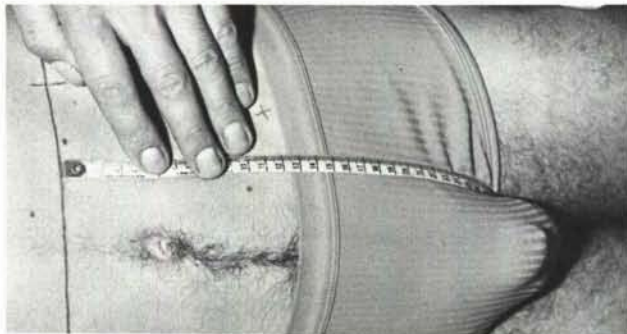
CROTCH LENGTH SERIAL NOS. 1663-2013

NB Waist located at natural waist indent

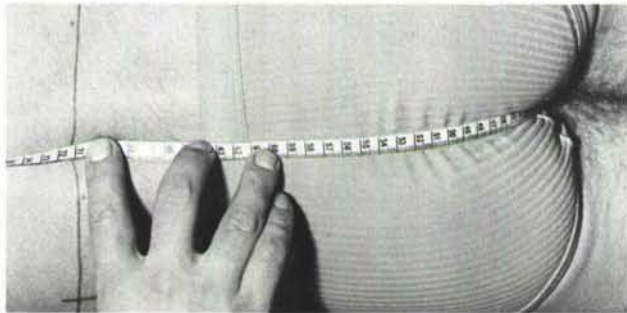
Standing erect. Measurement with tape passing vertically down from waist line through crotch to left of genitals and vertically up between buttocks to mid-line waist mark at back.

PERCENTILE VALUES		
%	mm	in.
1	632.8	24.91
2	648.4	25.53
3	654.0	25.75
5	660.4	26.00
10	679.4	26.75
15	689.5	27.15
20	697.6	27.46
25	702.9	27.67
30	709.0	27.91
35	714.9	28.15
40	719.3	28.32
45	724.8	28.53
50	731.7	28.81
55	738.3	29.07
60	745.6	29.35
65	751.7	29.59
70	757.6	29.83
75	763.6	30.06
80	769.9	30.31
85	777.9	30.62
90	789.6	31.09
95	808.7	31.84
97	821.6	32.35
98	830.1	32.68
99	858.1	33.78

Mean: 734.7 mm; 28.93 in.  
Standard deviation: 45.6 mm; 1.80 in.  
Coefficient of variation: 6.21%  
Range: 597.0 - 917.0 mm; 23.50 - 36.10 in.  
Number of subjects: 347



Front



Back

TABLE 37

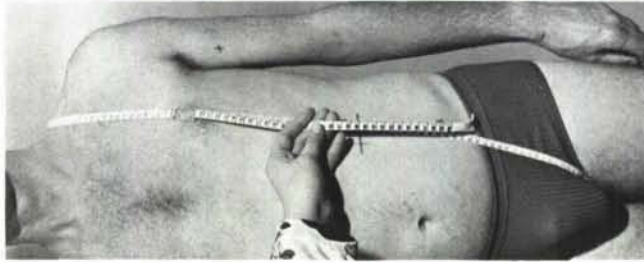
VERTICAL TRUNK CIRCUMFERENCE (MEAN)

Standing erect with shoulders relaxed, arms by sides. Measurement with tape passing back over left shoulder adjacent to 90 mm shoulder mark, down between buttocks, through crotch to left of the genitals and up front of body (spanning all body hollows) through metal loop on end of tape. Reading taken where tape passes through metal loop. Left and corresponding right measurements recorded; mean of these tabulated.

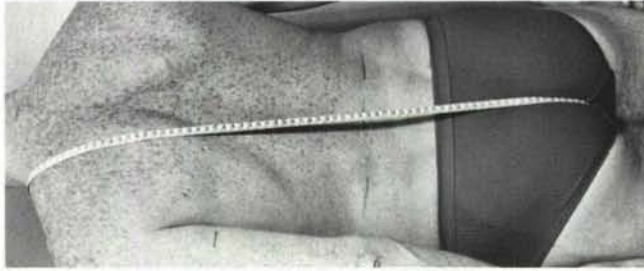
PERCENTILE VALUES		
%	mm	in.
1	1479.7	58.26
2	1494.4	58.83
3	1504.1	59.22
5	1516.1	59.69
10	1539.8	60.62
15	1555.9	61.26
20	1566.9	61.69
25	1577.6	62.11
30	1588.7	62.55
35	1598.0	62.91
40	1607.4	63.28
45	1615.4	63.60
50	1625.1	63.98
55	1632.2	64.26
60	1641.5	64.63
65	1650.5	64.98
70	1660.5	65.37
75	1670.3	65.76
80	1681.6	66.21
85	1693.9	66.69
90	1708.9	67.28
95	1732.0	68.19
97	1746.6	68.77
98	1759.5	69.27
99	1774.3	69.85

Mean: 1625.2 mm; 63.98 in.  
Standard Deviation: 65.5 mm; 2.58 in.  
Coefficient of Variation: 4.03%  
Range: 1411.5 - 1852.0 mm; 55.57 - 72.91 in.  
Number of Subjects: 2000

Check measure deviation: 11.5 mm; 0.7%



Front



Back



TABLE 38

WRIST CIRCUMFERENCE

Measurement with edge of tape lying immediately proximal to styloid process of ulna.

PERCENTILE VALUES

%	mm	in.
1	153.6	6.05
2	155.1	6.11
3	156.5	6.16
5	158.8	6.25
10	161.8	6.37
15	163.9	6.45
20	165.4	6.51
25	167.0	6.57
30	168.1	6.62
35	169.3	6.66
40	170.2	6.70
45	171.6	6.76
50	173.1	6.81
55	174.3	6.86
60	175.4	6.91
65	176.9	6.96
70	178.2	7.02
75	179.5	7.07
80	181.1	7.13
85	183.1	7.21
90	185.6	7.31
95	189.7	7.47
97	193.0	7.60
98	194.9	7.67
99	197.1	7.76

Mean: 173.9 mm; 6.85 in.  
Standard deviation: 9.5 mm; 0.37 in.  
Coefficient of variation: 5.44%  
Range: 146.0 - 210.0 mm; 5.75 - 8.27 in.  
Number of subjects: 1999

Check measure deviation: 3.0 mm; 1.7%



TABLE 39

ELBOW, FULLY BENT, CIRCUMFERENCE

Tape placed in crook of left elbow with elbow slightly bent initially so that edge of tape lies in elbow crease. Measurement with tape passing around maximum prominence of olecranon with subject touching left shoulder with left fingers.

PERCENTILE VALUES

%	mm	in.
1	303.3	11.94
2	308.4	12.14
3	310.0	12.20
5	314.0	12.36
10	319.6	12.58
15	324.1	12.76
20	327.5	12.89
25	330.5	13.01
30	333.1	13.12
35	335.1	13.19
40	337.5	13.29
45	339.6	13.37
50	342.1	13.47
55	344.3	13.56
60	346.7	13.65
65	349.4	13.76
70	351.9	13.85
75	354.5	13.96
80	357.2	14.06
85	360.0	14.17
90	364.2	14.34
95	370.8	14.60
97	375.5	14.78
98	379.1	14.93
99	384.0	15.12

Mean: 342.8 mm; 13.50 in.  
Standard deviation: 17.5 mm; 0.69 in.  
Coefficient of variation: 5.10%  
Range: 282.0 - 413.0 mm; 11.10 - 16.26 in.  
Number of subjects: 1998

Check measure deviation: 4.4 mm; 1.3%

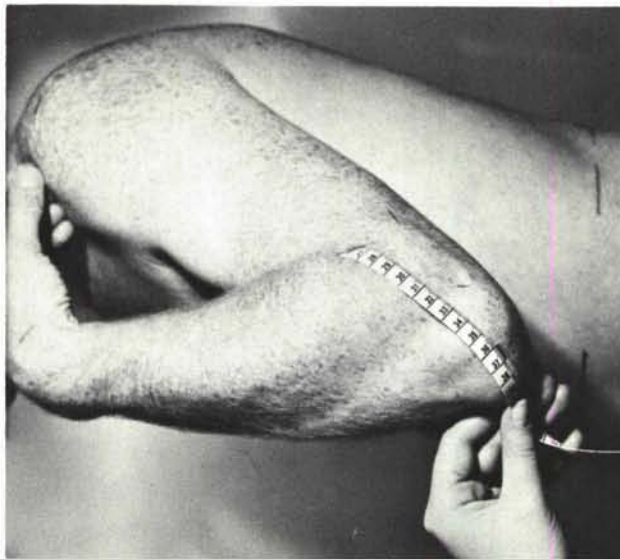




TABLE 40

KNEE, FULLY BENT, CIRCUMFERENCE

Tape placed around left knee with edge in knee crease with knee slightly bent initially. Measurement with tape passing over maximum prominence of vastus medialis with subject in squatting position (with left knee fully bent).

PERCENTILE VALUES

%	mm	in.
1	398.0	15.67
2	402.2	15.83
3	405.7	15.97
5	409.9	16.14
10	417.8	16.45
15	422.3	16.63
20	425.7	16.76
25	429.4	16.91
30	433.5	17.07
35	436.4	17.18
40	439.2	17.29
45	442.1	17.41
50	445.1	17.53
55	448.0	17.64
60	450.4	17.73
65	453.5	17.86
70	456.5	17.97
75	459.8	18.10
80	463.7	18.26
85	467.6	18.41
90	472.2	18.59
95	480.1	18.90
97	484.8	19.09
98	489.5	19.27
99	494.9	19.48

Mean: 445.5 mm; 17.54 in.  
Standard deviation: 21.4 mm; 0.84 in.  
Coefficient of variation: 4.80%  
Range: 378.0 - 516.0 mm; 14.88 - 20.31 in.  
Number of subjects: 1998  
Check measure deviation: 7.3 mm; 1.6%

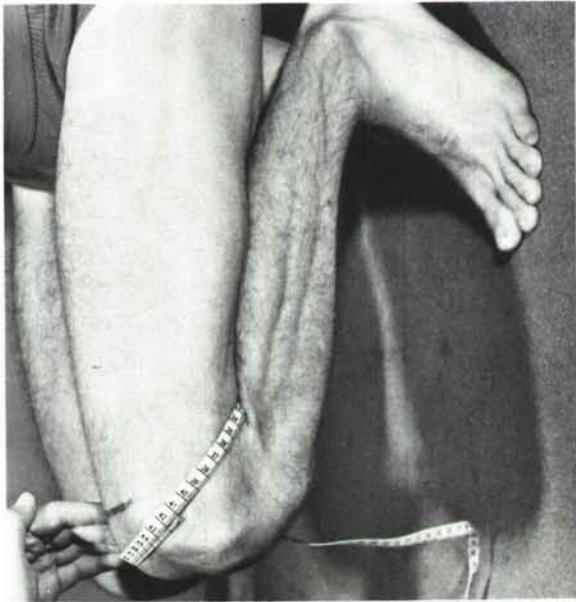


TABLE 41

BALL OF FOOT CIRCUMFERENCE

Sitting with shins vertical, feet flat on floor. Measurement with tape encircling ball of left foot including ends of first and fifth metatarsals.

PERCENTILE VALUES

%	mm	cm.
1	223.2	8.79
2	225.8	8.89
3	228.1	8.98
5	230.5	9.07
10	234.9	9.25
15	237.8	9.36
20	239.6	9.43
25	241.5	9.51
30	243.5	9.59
35	244.9	9.64
40	246.4	9.70
45	248.0	9.76
50	249.3	9.82
55	250.5	9.86
60	252.2	9.93
65	254.0	10.00
70	255.2	10.05
75	257.6	10.14
80	259.3	10.21
85	261.8	10.31
90	264.6	10.42
95	268.8	10.58
97	272.0	10.71
98	274.3	10.80
99	278.0	10.94

Mean: 250.1 mm; 9.85 in.  
Standard deviation: 11.6 mm; 0.46 in.  
Coefficient of variation: 4.64%  
Range: 214.0 - 290.0 mm; 8.43 - 11.42 in.  
Number of subjects: 2000  
Check measure deviation: 7.3 mm; 2.9%

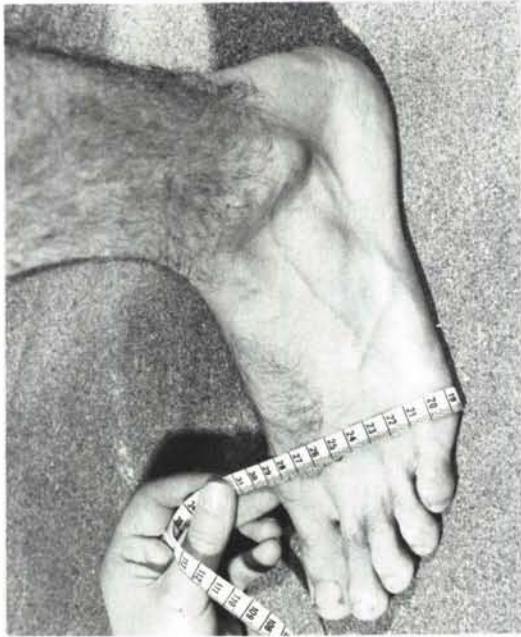


TABLE 42

## INSTEP-SOLE CIRCUMFERENCE

Sitting with shins vertical, feet flat on floor. Measurement with tape passing over intermediate cuneiform bone of left foot and under sole.

## PERCENTILE VALUES

%	mm	in.
1	221.5	8.72
2	225.2	8.87
3	227.5	8.96
5	229.3	9.03
10	232.9	9.17
15	235.7	9.28
20	238.0	9.37
25	239.4	9.43
30	240.7	9.47
35	242.3	9.54
40	243.6	9.59
45	244.8	9.64
50	246.3	9.70
55	248.0	9.76
60	249.4	9.82
65	250.5	9.86
70	252.1	9.93
75	253.8	9.99
80	255.8	10.07
85	258.1	10.16
90	260.4	10.25
95	264.9	10.43
97	268.0	10.55
98	269.9	10.63
99	273.3	10.76

Mean: 247.2 mm; 9.73 in.  
Standard deviation: 10.8 mm; 0.43 in.  
Coefficient of variation: 4.38%  
Range: 214.0 - 288.0 mm; 8.43 - 11.34 in.  
Number of subjects: 1999

Check measure deviation: 1.9 mm; 0.8%

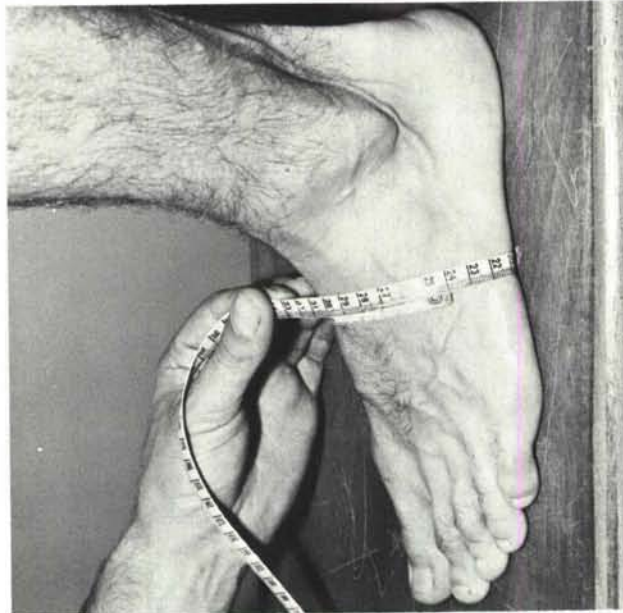


TABLE 43

## HEEL-INSTEP CIRCUMFERENCE

Sitting with shins vertical and left heel raised to maximum, toes remaining on floor. Measurement with tape passing over maximum prominence of heel and over proximal part of instep.

## PERCENTILE VALUES

%	mm	in.
1	294.0	11.57
2	298.3	11.75
3	300.1	11.81
5	302.7	11.92
10	307.4	12.10
15	311.0	12.25
20	313.8	12.35
25	315.6	12.43
30	317.8	12.51
35	319.7	12.59
40	321.4	12.65
45	323.0	12.72
50	324.7	12.78
55	326.5	12.85
60	328.3	12.93
65	329.8	12.99
70	331.9	13.07
75	333.9	13.14
80	335.8	13.22
85	338.7	13.33
90	341.7	13.45
95	348.0	13.70
97	352.1	13.86
98	354.8	13.97
99	359.0	14.13

Mean: 325.4 mm; 12.81 in.  
Standard deviation: 13.6 mm; 0.54 in.  
Coefficient of variation: 4.18%  
Range: 284.0 - 378.0 mm; 11.18 - 14.88 in.  
Number of Subjects: 1999

Check measure deviation: 3.4 mm; 1.0%

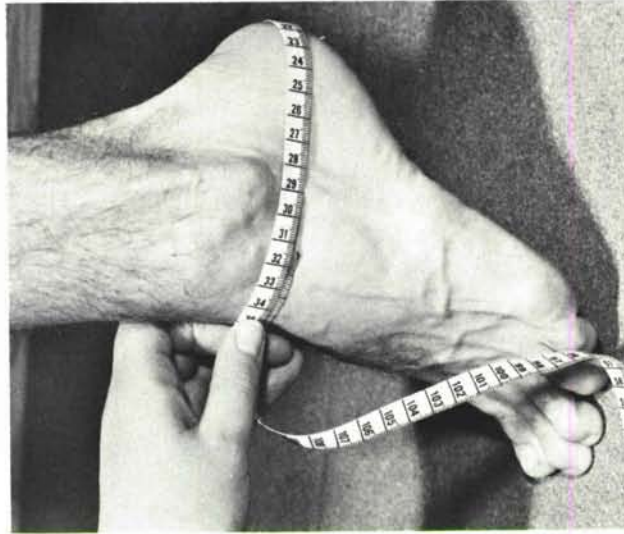
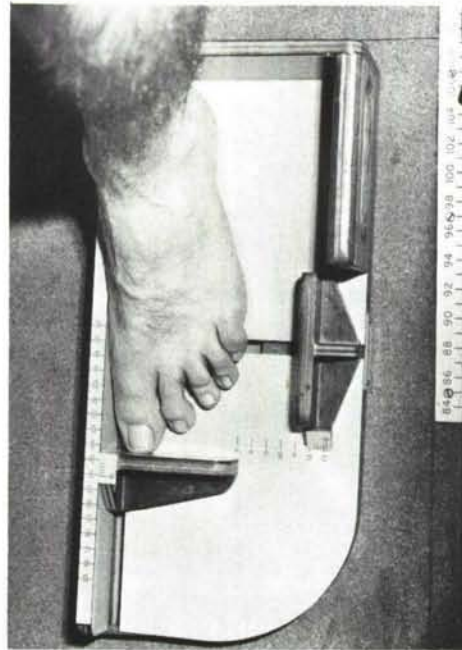




TABLE 44  
FOOT LENGTH

Sitting erect with left foot in foot box, heel against back face and inner side of foot against side of box. Measurement from back face of box to datum face of slide in light contact with tip of longest toe.



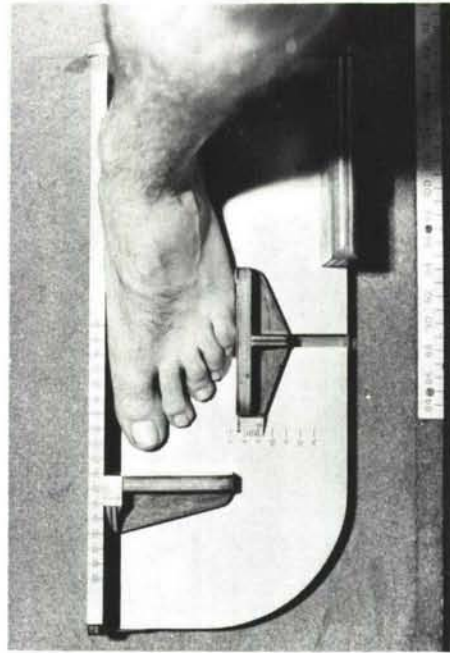
PERCENTILE VALUES		
%	mm	in.
1	238.5	9.39
2	241.5	9.51
3	244.0	9.61
5	246.9	9.72
10	250.2	9.85
15	253.0	9.96
20	255.1	10.04
25	257.0	10.12
30	258.8	10.19
35	260.4	10.25
40	261.8	10.31
45	263.3	10.37
50	264.9	10.43
55	266.5	10.49
60	268.5	10.57
65	270.1	10.63
70	271.8	10.70
75	273.6	10.77
80	275.7	10.85
85	278.0	10.95
90	280.9	11.06
95	285.4	11.24
97	289.1	11.38
98	291.0	11.46
99	296.5	11.67

Mean: 265.9 mm; 10.47 in.  
Standard Deviation: 12.1 mm; 0.48 in.  
Coefficient of Variation: 4.55%  
Range: 219.0 - 309.0 mm; 8.62 - 12.17 in.  
Number of Subjects: 2000

Check measure deviation: 1.7 mm; 0.6%

TABLE 45  
FOOT BREADTH

Sitting erect with left foot in foot box, heel against back face and inner side of foot against side of box. Measurement from side face of box to datum face of slide in light contact with widest point of foot.



PERCENTILE VALUES		
%	mm	in.
1	85.8	3.38
2	86.6	3.41
3	87.1	3.43
5	88.0	3.46
10	89.4	3.52
15	90.4	3.56
20	91.2	3.59
25	91.8	3.61
30	92.5	3.64
35	93.1	3.67
40	93.6	3.69
45	94.2	3.71
50	94.7	3.73
55	95.4	3.75
60	96.0	3.78
65	96.6	3.80
70	97.2	3.83
75	97.8	3.85
80	98.5	3.88
85	99.3	3.91
90	100.5	3.95
95	102.2	4.03
97	103.5	4.08
98	104.4	4.11
99	106.2	4.18

Mean: 95.4 mm; 3.76 in.  
Standard Deviation: 4.4 mm; 0.17 in.  
Coefficient of Variation: 4.57%  
Range: 83.0 - 113.0 mm; 3.27 - 4.45 in.  
Number of Subjects: 1998

Check measure deviation: 0.9 mm; 0.9%



TABLE 46

HEAD CIRCUMFERENCE

Head forward facing. Measurement with tape passing around head just above brow ridges and over occiput (tape tension sufficient to flatten hair).

PERCENTILE VALUES

%	mm	in.
1	546.6	21.52
2	549.5	21.63
3	551.4	21.71
5	554.4	21.83
10	558.7	22.00
15	561.6	22.11
20	564.4	22.22
25	566.6	22.31
30	568.9	22.40
35	570.6	22.47
40	573.1	22.56
45	574.6	22.62
50	576.2	22.69
55	578.1	22.76
60	579.7	22.82
65	581.6	22.90
70	583.3	22.96
75	585.1	23.03
80	587.5	23.13
85	590.3	23.24
90	594.0	23.39
95	598.9	23.58
97	602.6	23.73
98	604.8	23.81
99	608.4	23.95

Mean: 576.7 mm; 22.71 in.  
Standard Deviation: 13.6 mm; 0.54 in.  
Coefficient of Variation: 2.36%  
Range: 530.0 - 624.0 mm; 20.87 - 24.57 in.  
Number of Subjects: 2000

Check measure deviation: 2.8 mm; 0.5%

TABLE 47

BITRAGION-CORONAL ARC

Measurement from tragon of one ear vertically over head to tragon of other ear (tape tension sufficient to flatten hair).

PERCENTILE VALUES

%	mm	in.
1	323.6	12.74
2	327.5	12.89
3	329.7	12.98
5	332.0	13.07
10	336.6	13.25
15	340.6	13.41
20	342.3	13.48
25	344.4	13.56
30	346.3	13.63
35	348.1	13.71
40	349.8	13.77
45	351.4	13.84
50	352.9	13.89
55	354.4	13.95
60	355.8	14.01
65	357.6	14.08
70	359.4	14.15
75	361.1	14.21
80	362.7	14.28
85	365.1	14.37
90	368.6	14.51
95	373.9	14.72
97	377.0	14.84
98	380.5	14.98
99	385.2	15.17

Mean: 353.4 mm; 13.91 in.  
Standard Deviation: 12.6 mm; 0.50 in.  
Coefficient of Variation: 3.56%  
Range: 311.0 - 404.0 mm; 12.24 - 15.91 in.  
Number of Subjects: 2000

Check measure deviation: 1.7 mm; 0.5%

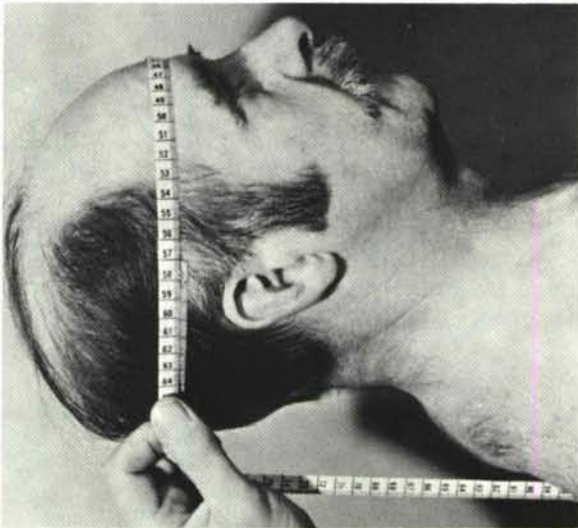
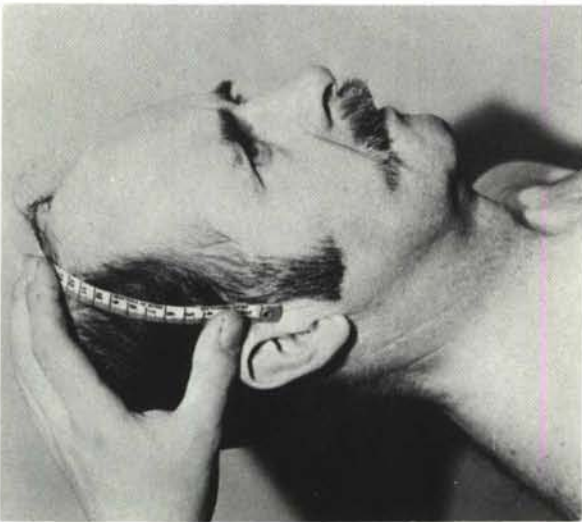
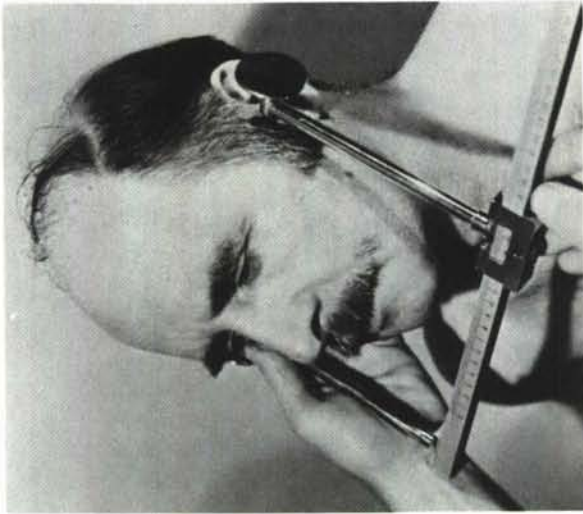


TABLE 49  
BITRACION DIAMETER

Measurement with ball ends of head caliper in light contact with both tragus.

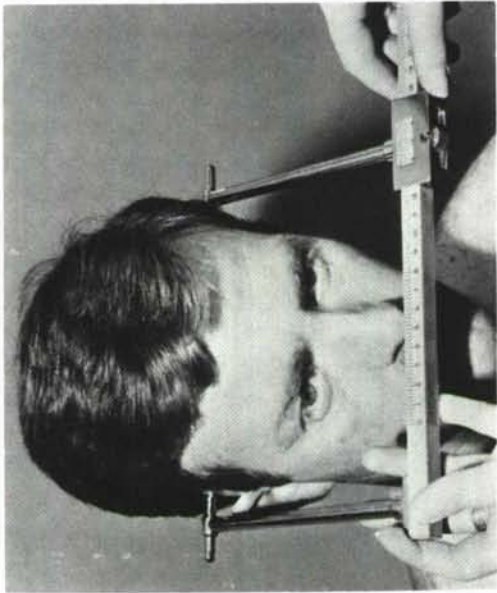


PERCENTILE VALUES		
%	mm	in.
1	127.1	5.00
2	128.5	5.06
3	129.3	5.09
5	130.3	5.13
10	132.2	5.21
15	133.6	5.26
20	134.5	5.30
25	135.3	5.33
30	136.0	5.35
35	136.7	5.38
40	137.4	5.41
45	137.9	5.43
50	138.5	5.45
55	139.1	5.48
60	139.7	5.50
65	140.4	5.53
70	141.1	5.56
75	141.8	5.58
80	142.8	5.62
85	143.8	5.66
90	144.9	5.71
95	146.9	5.78
97	148.6	5.85
98	149.8	5.90
99	151.5	5.96

Mean: 139.1 mm; 5.48 in.  
Standard deviation: 5.0 mm; 0.20 in.  
Coefficient of variation: 3.60%  
Range: 122.0 - 157.0 mm; 4.80 - 6.18 in.  
Number of subjects: 2000  
Check measure deviation: 0.4 mm; 0.3%

TABLE 48  
HEAD BREADTH

Measurement with disc heads of head caliper placed over maximum breadth of head (pressure sufficient to flatten hair).



PERCENTILE VALUES		
%	mm	in.
1	144.8	5.70
2	145.8	5.74
3	147.1	5.79
5	148.6	5.85
10	150.4	5.92
15	151.6	5.97
20	152.7	6.01
25	153.6	6.05
30	154.4	6.08
35	155.3	6.11
40	155.9	6.14
45	156.6	6.17
50	157.3	6.19
55	158.0	6.22
60	158.8	6.25
65	159.5	6.28
70	160.2	6.31
75	161.1	6.34
80	161.9	6.37
85	163.0	6.42
90	164.2	6.46
95	165.9	6.53
97	167.8	6.60
98	168.8	6.65
99	170.6	6.72

Mean: 157.8 mm; 6.21 in.  
Standard Deviation: 5.4 mm; 0.21 in.  
Coefficient of Variation: 3.45%  
Range: 140.0 - 180.0 mm; 5.51 - 7.09 in.  
Number of Subjects: 2000  
Check measure deviation: 3.8 mm; 2.4%

TABLE 50

MAXIMUM HEAD DIAGONAL FROM MENTON

Fixed disc head of head caliper placed on chin of closed jaw and other disc head moved about vertex to determine position of maximum diagonal. Measurement from vertex to fixed disc head of caliper in light contact with chin.

PERCENTILE VALUES

%	mm	in.
1	244.7	9.64
2	246.3	9.70
3	247.2	9.73
5	249.0	9.80
10	251.7	9.91
15	253.6	9.98
20	255.2	10.05
25	256.4	10.10
30	257.6	10.14
35	258.7	10.19
40	259.6	10.22
45	260.6	10.26
50	261.5	10.30
55	262.4	10.33
60	263.3	10.37
65	264.3	10.40
70	265.4	10.45
75	266.6	10.50
80	267.8	10.54
85	269.4	10.61
90	271.6	10.69
95	275.1	10.83
97	276.8	10.90
98	277.8	10.94
99	280.3	11.03

Mean: 262.1 mm; 10.32 in.  
Standard deviation: 7.7 mm; 0.30 in.  
Coefficient of variation: 2.93%  
Range: 237.0 - 286.0 mm; 9.33 - 11.26 in.  
Number of subjects: 1999

Check measure deviation: 3.9 mm; 1.5%

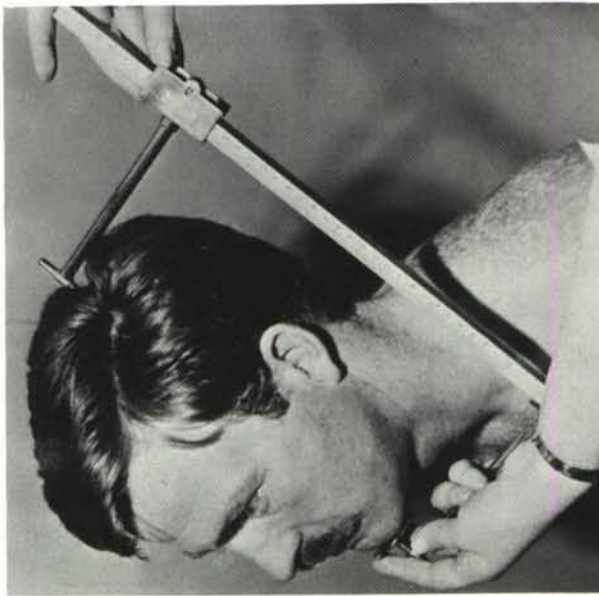


TABLE 51

MENTON TO BACK OF HEAD

Sitting (head measuring rig). Measurement of horizontal distance from back of head box to datum face of pointer in light contact with front of chin.

PERCENTILE VALUES

%	mm	in.
1	174.4	6.87
2	177.1	6.97
3	178.7	7.04
5	181.3	7.14
10	185.2	7.29
15	188.0	7.40
20	190.2	7.49
25	191.9	7.56
30	193.9	7.63
35	195.5	7.70
40	197.0	7.76
45	198.5	7.81
50	199.7	7.86
55	200.9	7.91
60	201.9	7.95
65	203.4	8.01
70	205.0	8.07
75	206.9	8.14
80	208.2	8.20
85	210.3	8.28
90	213.0	8.38
95	216.6	8.53
97	219.0	8.62
98	220.7	8.69
99	224.0	8.82

Mean: 199.8 mm; 7.87 in.  
Standard deviation: 10.7 mm; 0.42 in.  
Coefficient of variation: 5.37%  
Range: 160.0 - 240.0 mm; 6.30 - 9.45 in.  
Number of subjects: 1998

Check measure deviation: 5.4 mm; 2.7%

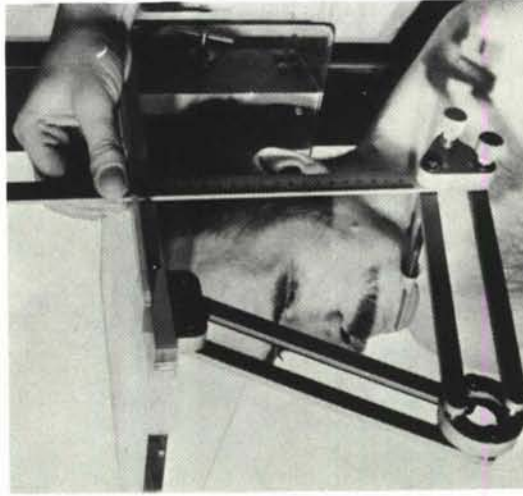




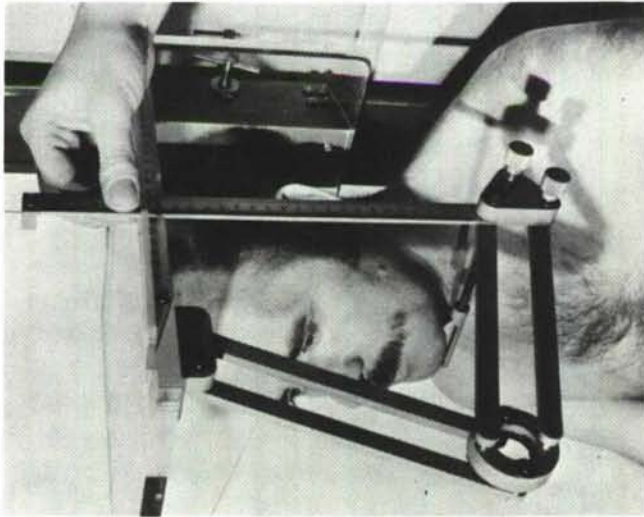
TABLE 52

MENTON TO VERTEX

Sitting (head measuring rig). Measurement of vertical distance from roof of head box to datum face of pointer in light contact with lower surface of chin.

PERCENTILE VALUES

%	mm.	in.
1	203.9	8.03
2	207.6	8.17
3	210.0	8.27
5	212.3	8.36
10	216.2	8.51
15	219.1	8.62
20	221.1	8.71
25	222.5	8.76
30	223.8	8.81
35	225.1	8.86
40	226.5	8.92
45	227.7	8.96
50	229.0	9.01
55	230.2	9.06
60	231.5	9.11
65	232.8	9.17
70	234.3	9.22
75	235.8	9.28
80	237.6	9.35
85	239.5	9.43
90	241.7	9.51
95	245.4	9.66
97	247.9	9.76
98	249.6	9.83
99	252.4	9.94



Mean: 229.5 mm; 9.04 in.  
Standard deviation: 10.1 mm; 0.40 in.  
Coefficient of variation: 4.39%  
Range: 191.0 - 262.0 mm; 7.52 - 10.31 in.  
Number of subjects: 2000

Check measure deviation: 9.6 mm; 4.1%

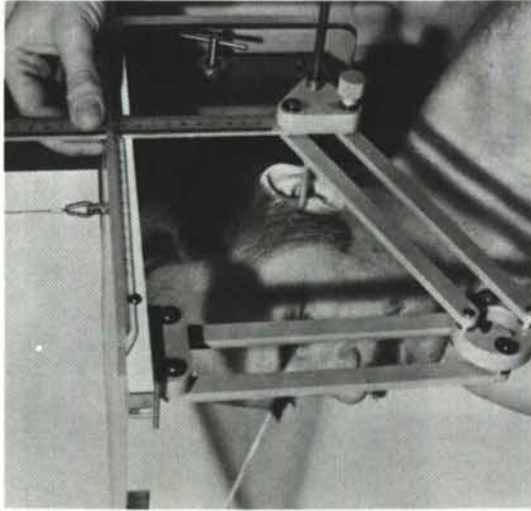
TABLE 53

TRAGION TO BACK OF HEAD

Sitting (head measuring rig). Measurement of horizontal distance from back of head box to datum edge of pointer aligned with left tragon.

PERCENTILE VALUES

%	mm.	in.
1	85.5	3.37
2	87.3	3.44
3	88.3	3.47
5	90.1	3.55
10	92.3	3.64
15	93.7	3.69
20	95.2	3.75
25	95.9	3.78
30	97.2	3.83
35	98.0	3.86
40	99.1	3.90
45	99.8	3.93
50	101.1	3.98
55	101.7	4.01
60	102.6	4.04
65	103.5	4.07
70	104.3	4.11
75	105.5	4.15
80	106.6	4.20
85	107.8	4.24
90	109.7	4.32
95	112.6	4.43
97	113.9	4.48
98	115.4	4.54
99	117.7	4.63



Mean: 101.4 mm; 3.99 in.  
Standard deviation: 6.9 mm; 0.27 in.  
Coefficient of variation: 6.84%  
Range: 78.0 - 141.0 mm; 3.07 - 5.55 in.  
Number of subjects: 2000

Check measure deviation: 6.8 mm; 6.9%

TABLE 54

TRAGION TO VERTEX

Sitting (head measuring rig). Measurement of vertical distance from roof of head box to datum edge of pointer aligned with left tragon.

PERCENTILE VALUES

%	mm	in.
1	114.2	4.50
2	116.8	4.60
3	118.1	4.65
5	119.5	4.71
10	121.5	4.79
15	123.2	4.85
20	124.6	4.90
25	125.5	4.94
30	126.4	4.97
35	127.3	5.01
40	128.0	5.04
45	129.1	5.08
50	129.8	5.11
55	130.7	5.15
60	131.5	5.18
65	132.3	5.21
70	133.3	5.25
75	134.2	5.28
80	135.2	5.32
85	136.3	5.36
90	137.8	5.43
95	139.9	5.51
97	141.3	5.56
98	142.2	5.60
99	144.6	5.69

Mean: 130.3 mm; 5.13 in.  
Standard deviation: 6.4 mm; 0.25 in.  
Coefficient of variation: 4.93%  
Range: 95.0 - 156.0 mm; 3.74 - 6.14 in.  
Number of subjects: 2000

Check measure deviation: 6.5 mm; 4.9%

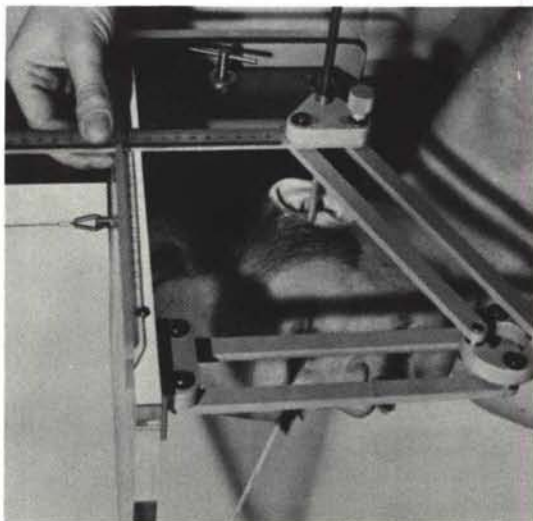


TABLE 55

PUPIL TO VERTEX

Sitting (head measuring rig). Measurement of vertical distance from roof of head box to datum edge of pointer, raised until subject sees datum edge bisect left pupil in vertical mirror opposite.

PERCENTILE VALUES

%	mm	in.
1	92.4	3.64
2	94.8	3.73
3	96.8	3.81
5	98.5	3.88
10	101.3	3.99
15	103.4	4.07
20	105.0	4.13
25	106.5	4.19
30	107.7	4.24
35	109.1	4.30
40	110.0	4.33
45	111.2	4.38
50	112.1	4.41
55	113.3	4.46
60	114.3	4.50
65	115.4	4.54
70	116.6	4.59
75	117.7	4.63
80	119.0	4.69
85	120.5	4.75
90	122.7	4.83
95	125.7	4.95
97	127.5	5.02
98	128.7	5.07
99	130.2	5.12

Mean: 112.6 mm; 4.43 in.  
Standard deviation: 8.2 mm; 0.32 in.  
Coefficient of variation: 7.31%  
Range: 85.0 - 138.0 mm; 3.35 - 5.43 in.  
Number of subjects: 2000

Check measure deviation: 11.6 mm; 10.2%



TABLE 56

NASION TO VERTEX

Sitting (head measuring rig). Measurement of vertical distance from roof of head box to datum edge of pointer in light contact with nasion (located by palpation).

PERCENTILE VALUES

%	mm	in.
1	83.7	3.29
2	85.9	3.38
3	88.0	3.46
5	90.1	3.55
10	92.9	3.66
15	95.8	3.77
20	97.6	3.84
25	99.1	3.90
30	100.6	3.96
35	102.1	4.02
40	103.4	4.07
45	104.6	4.12
50	106.0	4.17
55	107.2	4.22
60	108.2	4.26
65	109.5	4.31
70	111.0	4.37
75	112.3	4.42
80	113.9	4.48
85	115.9	4.56
90	118.7	4.67
95	121.7	4.79
97	124.0	4.88
98	125.3	4.93
99	127.5	5.02

Mean: 106.3 mm; 4.19 in.  
Standard deviation: 9.6 mm; 0.38 in.  
Coefficient of variation: 9.07%  
Range: 75.0 - 136.0 mm; 2.95 - 5.35 in.  
Number of subjects: 2000  
Check measure deviation: 12.2 mm; 11.3%

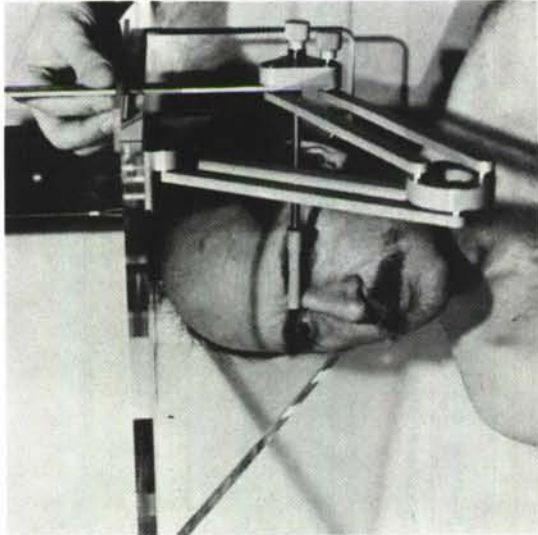


TABLE 57

HEAD LENGTH

Sitting (head measuring rig). Measurement of horizontal distance from back of head box to datum face of pointer in light contact with maximum prominence of glabella or brow ridge.

PERCENTILE VALUES

%	mm	in.
1	183.2	7.21
2	185.0	7.28
3	186.3	7.33
5	187.9	7.40
10	190.5	7.50
15	192.0	7.56
20	193.2	7.61
25	193.9	7.64
30	195.0	7.68
35	195.7	7.71
40	196.8	7.75
45	197.7	7.78
50	198.5	7.82
55	199.3	7.85
60	200.0	7.87
65	201.1	7.92
70	201.9	7.95
75	202.9	7.99
80	203.9	8.03
85	205.2	8.08
90	206.7	8.14
95	208.7	8.22
97	210.0	8.27
98	211.3	8.32
99	213.3	8.40

Mean: 199.0 mm; 7.83 in.  
Standard deviation: 6.4 mm; 0.25 in.  
Coefficient of variation: 3.20%  
Range: 178.0 - 220.0 mm; 7.01 - 8.66 in.  
Number of subjects: 2000  
Check measure deviation: 2.5 mm; 1.3%

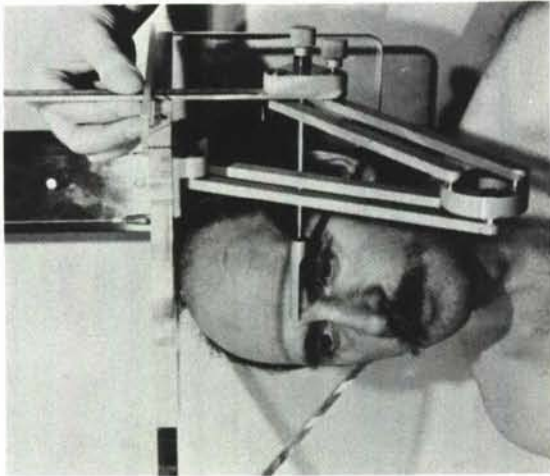




TABLE 58

BUTTOCK-HEEL LENGTH

Sitting on rig floor, back to end wall. With both legs straight, buttocks pushed back to wall as far as possible. Measurement from end wall to heel block in light contact with left heel, using scale along rig floor. N.B. For clarity only, illustration shows right leg flexed.

PERCENTILE VALUES

%	mm	in.
1	974.5	38.37
2	989.6	38.96
3	997.9	39.29
5	1007.1	39.65
10	1021.9	40.23
15	1035.0	40.75
20	1045.2	41.15
25	1054.1	41.50
30	1062.1	41.82
35	1069.5	42.11
40	1075.8	42.36
45	1082.5	42.62
50	1087.9	42.83
55	1094.8	43.10
60	1100.5	43.33
65	1109.1	43.66
70	1115.8	43.93
75	1125.3	44.30
80	1134.9	44.68
85	1143.8	45.03
90	1155.2	45.48
95	1173.1	46.19
97	1188.1	46.78
98	1201.1	47.29
99	1210.7	47.66



Mean: 1089.9 mm; 42.91 in.  
Standard deviation: 51.4 mm; 2.02 in.  
Coefficient of variation: 4.71%  
Range: 889.0 - 1276.0 mm; 35.00 - 50.24 in.  
Number of subjects: 1993  
Check measure deviation: 12.0 mm; 1.1%

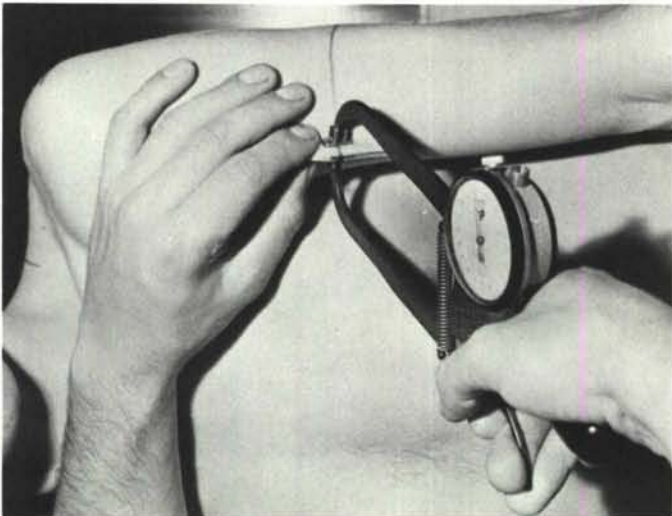
TABLE 59

BICEPS SKINFOLD

Skinfold measurement at biceps skin mark.

PERCENTILE VALUES

%	mm	in.
1	2.2	0.09
2	2.4	0.10
3	2.5	0.10
5	2.7	0.11
10	3.0	0.12
15	3.2	0.13
20	3.4	0.14
25	3.6	0.14
30	3.9	0.15
35	4.1	0.16
40	4.3	0.17
45	4.5	0.18
50	4.7	0.19
55	4.9	0.19
60	5.2	0.20
65	5.4	0.21
70	5.8	0.23
75	6.2	0.24
80	6.6	0.26
85	7.2	0.28
90	8.0	0.31
95	9.3	0.37
97	10.1	0.40
98	11.0	0.43
99	12.2	0.48

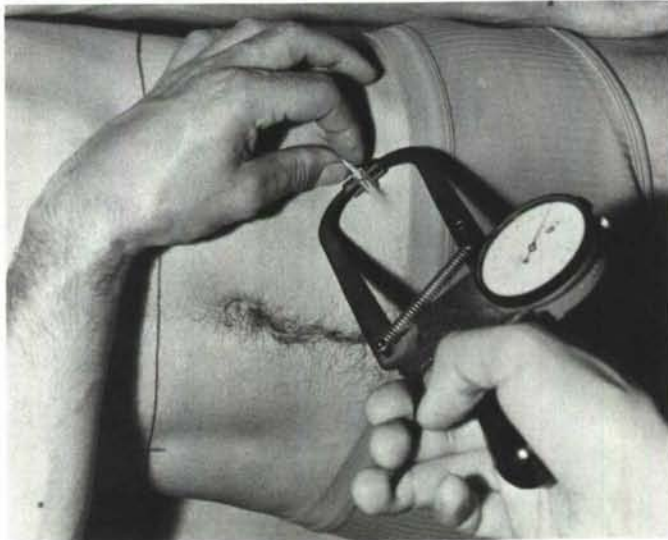


Mean: 5.2 mm; 0.21 in.  
Standard Deviation: 2.1 mm; 0.08 in.  
Coefficient of Variation: 40.51%  
Range: 2.0 - 18.9 mm; 0.08 - 0.74 in.  
Number of Subjects: 1997  
Check measure deviation: 1.0 mm; 20.1%

TABLE 60

SUPRAILIAC SKINFOLD

Skinfold measurement at suprailiac skin mark, parallel to line of external oblique muscle.



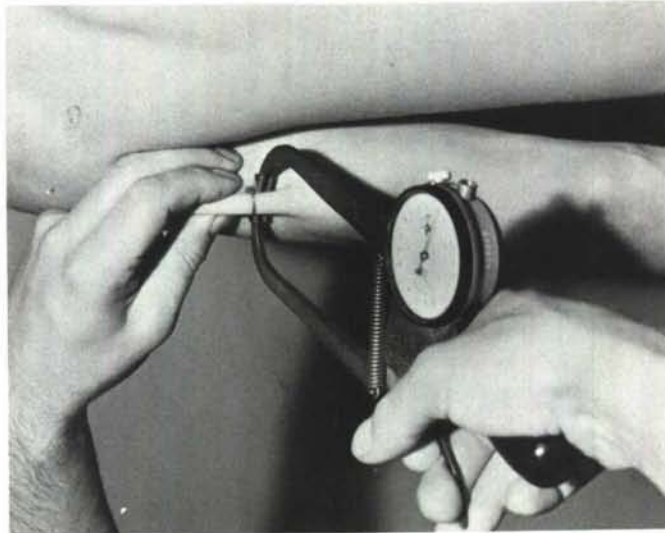
PERCENTILE VALUES		
%	mm	in.
1	3.5	0.14
2	3.8	0.15
3	4.0	0.16
5	4.2	0.17
10	4.7	0.19
15	5.1	0.20
20	5.5	0.22
25	5.9	0.23
30	6.2	0.25
35	6.6	0.26
40	6.9	0.27
45	7.3	0.29
50	7.8	0.31
55	8.3	0.33
60	8.8	0.35
65	9.4	0.37
70	9.9	0.39
75	10.6	0.42
80	11.3	0.44
85	12.0	0.47
90	13.1	0.52
95	15.1	0.59
97	16.1	0.63
98	17.5	0.69
99	19.2	0.76

Mean: 8.6 mm; 0.34 in.  
Standard Deviation: 3.5 mm; 0.14 in.  
Coefficient of Variation: 40.88%  
Range: 2.6 - 32.2 mm; 0.10 - 1.27 in.  
Number of Subjects: 1999  
Check measure deviation: 0.9 mm; 10.0%

TABLE 61

TRICEPS SKINFOLD

Skinfold measurement at triceps skin mark.



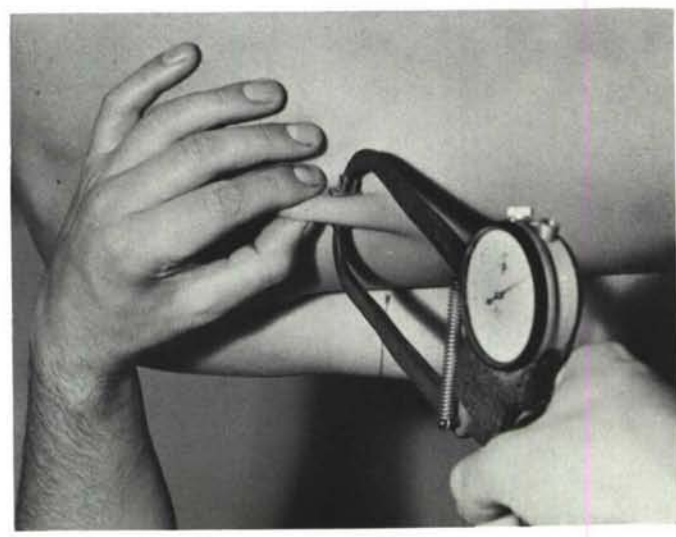
PERCENTILE VALUES		
%	mm	in.
1	4.2	0.17
2	4.6	0.18
3	5.0	0.20
5	5.4	0.21
10	6.3	0.25
15	7.0	0.28
20	7.6	0.30
25	8.1	0.32
30	8.6	0.34
35	9.1	0.36
40	9.7	0.38
45	10.2	0.40
50	10.7	0.42
55	11.2	0.44
60	11.7	0.46
65	12.3	0.48
70	12.8	0.50
75	13.4	0.53
80	14.0	0.55
85	14.8	0.58
90	16.2	0.64
95	18.2	0.71
97	19.5	0.77
98	20.3	0.80
99	21.9	0.86

Mean: 11.1 mm; 0.44 in.  
Standard Deviation: 3.9 mm; 0.15 in.  
Coefficient of Variation: 35.03%  
Range: 3.1 - 25.5 mm; 0.12 - 1.00 in.  
Number of Subjects: 1997  
Check measure deviation: 0.3 mm; 2.3%

TABLE 62

SUBSCAPULAR SKINFOLD

Skinfold measurement immediately below angle of scapula, parallel to its vertebral border.



PERCENTILE VALUES

%	mm	in.
1	6.4	0.25
2	6.7	0.27
3	7.0	0.27
5	7.4	0.29
10	8.0	0.32
15	8.6	0.34
20	9.2	0.36
25	9.6	0.38
30	10.0	0.39
35	10.6	0.42
40	11.1	0.44
45	11.5	0.45
50	12.0	0.47
55	12.6	0.50
60	13.3	0.52
65	13.9	0.55
70	14.6	0.58
75	15.6	0.61
80	16.7	0.66
85	17.9	0.70
90	19.4	0.76
95	22.7	0.89
97	24.8	0.98
98	26.5	1.04
99	28.8	1.13

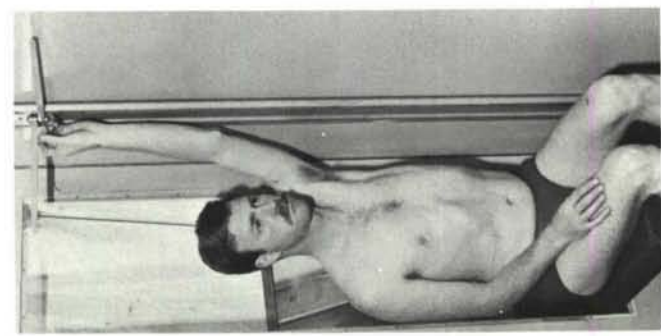
Mean: 13.2 mm; 0.52 in.  
 Standard Deviation: 4.8 mm; 0.19 in.  
 Coefficient of Variation: 36.37%  
 Range: 5.2 - 34.4 mm; 0.20 - 1.35 in.  
 Number of Subjects: 1995

Check measure deviation: 1.1 mm; 8.6%

TABLE 63

VERTICAL FUNCTIONAL REACH, SITTING

Sitting erect with back and buttocks firmly against end wall. Left arm raised vertically to maximum without raising buttocks, forefinger and thumb opposed and thumb in line with extended arm. Measurement from floor to datum probe at tip of left thumb. Vertical functional reach derived by subtraction of stool height from this measurement.



PERCENTILE VALUES

%	mm	in.
1	1265.7	49.83
2	1275.5	50.22
3	1280.6	50.42
5	1290.6	50.81
10	1309.9	51.57
15	1324.7	52.15
20	1334.4	52.53
25	1344.5	52.93
30	1352.1	53.23
35	1359.6	53.53
40	1367.5	53.84
45	1374.0	54.10
50	1384.6	54.51
55	1392.5	54.82
60	1399.8	55.11
65	1405.4	55.33
70	1412.9	55.63
75	1422.8	56.02
80	1431.6	56.36
85	1442.3	56.78
90	1453.6	57.23
95	1466.7	57.74
97	1478.0	58.19
98	1496.3	58.91
99	1515.3	59.66

Mean: 1383.5 mm; 54.47 in.  
 Standard deviation: 55.3 mm; 2.18 in.  
 Coefficient of variation: 4.00%  
 Range: 1214.0 - 1569.0 mm; 47.80 - 61.77 in.  
 Number of subjects: 587



TABLE 64

THIGH CLEARANCE HEIGHT

Sitting erect with shins vertical, feet flat on floor. Measurement from floor to datum probe at highest point of upper surface of left thigh. Thigh clearance height derived by subtraction of stool height from this measurement.

PERCENTILE VALUES

%	mm	in.
1	131.9	5.19
2	135.8	5.34
3	137.1	5.40
5	139.2	5.48
10	142.5	5.61
15	145.0	5.71
20	147.1	5.79
25	148.9	5.86
30	150.9	5.94
35	153.1	6.03
40	154.4	6.08
45	156.0	6.14
50	157.6	6.20
55	159.2	6.27
60	161.0	6.34
65	162.4	6.39
70	164.2	6.46
75	165.6	6.52
80	167.5	6.60
85	169.8	6.69
90	172.8	6.80
95	177.6	6.99
97	180.2	7.09
98	183.2	7.21
99	190.6	7.50

Mean: 158.4 mm; 6.23 in.  
Standard deviation: 12.2 mm; 0.48 in.  
Coefficient of variation: 7.73%  
Range: 128.0 - 227.0 mm; 5.04 - 8.94 in.  
Number of subjects: 588

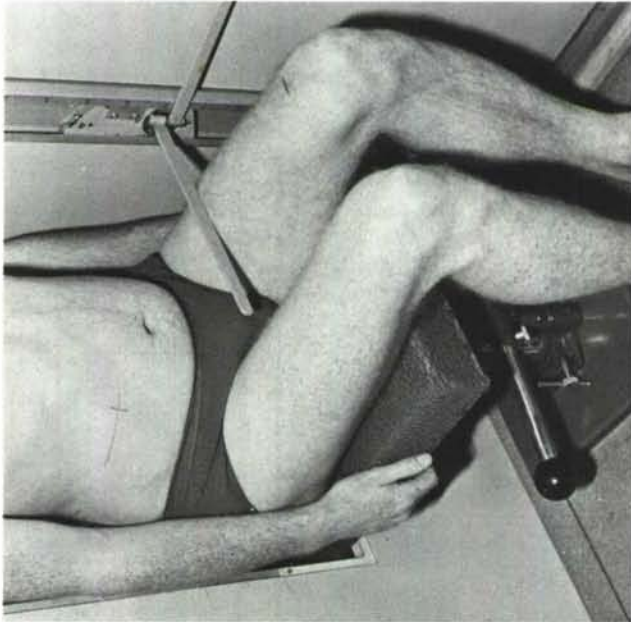


TABLE 65

ELBOW-FUNCTIONAL REACH

Standing erect, elbow in light contact with end wall. Left forearm horizontal and parallel to rear wall with forefinger and thumb opposed, thumb being held in line with extended forearm. Measurement from end wall to datum probe at tip of left thumb.

PERCENTILE VALUES

%	mm	in.
1	375.9	14.80
2	378.9	14.92
3	383.6	15.10
5	387.9	15.27
10	396.0	15.59
15	400.8	15.78
20	403.6	15.89
25	406.7	16.01
30	409.7	16.13
35	412.6	16.24
40	415.1	16.34
45	416.8	16.41
50	419.2	16.50
55	421.3	16.59
60	423.8	16.68
65	426.6	16.80
70	429.4	16.91
75	431.6	16.99
80	434.1	17.09
85	438.0	17.24
90	443.1	17.44
95	450.3	17.73
97	457.6	18.02
98	461.6	18.17
99	464.4	18.28

Mean: 420.0 mm; 16.53 in.  
Standard Deviation: 19.0 mm; 0.75 in.  
Coefficient of Variation: 4.53%  
Range: 369.0 - 496.0 mm; 14.53 - 19.53 in.  
Number of Subjects: 587



TABLE 66

STOMACH DEPTH

Sitting erect with back and buttocks firmly against end wall. Measurement from end wall to datum probe at maximum protrusion of abdomen.

PERCENTILE VALUES

%	mm	in.
1	192.4	7.58
2	201.2	7.92
3	202.9	7.99
5	206.1	8.12
10	213.1	8.39
15	218.9	8.62
20	221.7	8.73
25	225.4	8.87
30	229.1	9.02
35	232.2	9.14
40	234.7	9.24
45	237.5	9.35
50	239.9	9.45
55	243.0	9.57
60	245.8	9.68
65	249.3	9.81
70	252.8	9.95
75	255.3	10.05
80	260.1	10.24
85	263.9	10.39
90	269.1	10.60
95	281.2	11.07
97	287.4	11.31
98	296.2	11.66
99	306.2	12.06

Mean: 242.0 mm; 9.53 in.  
Standard Deviation: 22.9 mm; 0.90 in.  
Coefficient of Variation: 9.46%  
Range: 188.0 - 328.0 mm; 7.40 - 12.91 in.  
Number of Subjects: 588

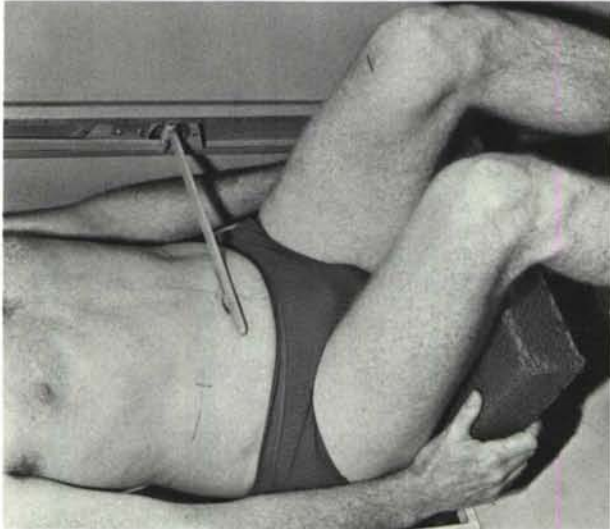


TABLE 67

REPEAT MEASURE USA TECHNIQUE -STATURE

Standing erect head forward facing. Measurement from floor to datum probe of anthropometer at vertex (maintaining instrument in vertical position).

PERCENTILE VALUES

%	mm	in.
1	1631.3	64.22
2	1647.0	64.84
3	1655.4	65.17
5	1668.3	65.68
10	1688.9	66.49
15	1704.2	67.09
20	1717.4	67.61
25	1727.8	68.02
30	1737.5	68.41
35	1746.2	68.75
40	1754.5	69.08
45	1762.3	69.38
50	1770.0	69.69
55	1777.0	69.96
60	1783.9	70.23
65	1792.8	70.58
70	1801.4	70.92
75	1809.2	71.23
80	1819.8	71.65
85	1833.5	72.18
90	1848.8	72.79
95	1873.9	73.77
97	1890.1	74.41
98	1902.0	74.88
99	1919.5	75.57

Mean: 1770.0 mm; 69.69 in.  
Standard deviation: 62.0 mm; 2.44 in.  
Coefficient of variation: 3.50%  
Range: 1509.0 - 1999.0 mm; 59.41 - 78.70 in.  
Number of subjects: 1996

Check measure deviation: 7.8 mm; 0.4%

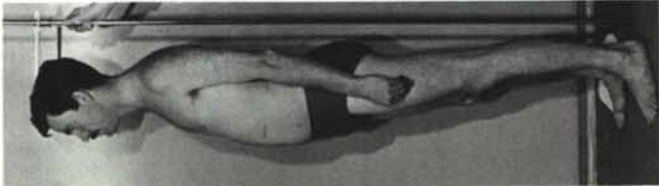
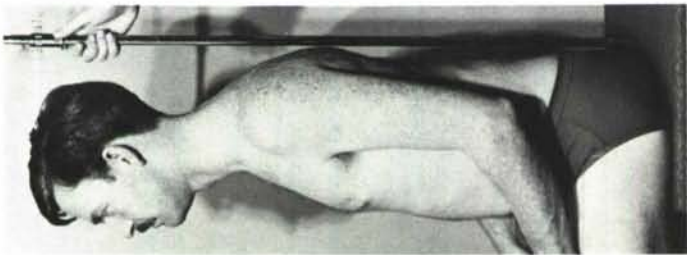


TABLE 68

REPEAT MEASURE USA TECHNIQUE -SITTING HEIGHT

Sitting erect head forward facing, shoulders relaxed. Elbows held lightly against sides with hands on mid-thighs. Measurement from stool sitting surface to datum probe of anthropometer at vertex (maintaining instrument in vertical position).



PERCENTILE VALUES		
%	mm	in.
1	855.0	33.66
2	863.0	33.98
3	868.4	34.19
5	877.4	34.54
10	889.9	35.04
15	897.2	35.32
20	902.7	35.54
25	907.8	35.74
30	913.3	35.96
35	917.4	36.12
40	921.4	36.28
45	925.2	36.42
50	929.3	36.59
55	933.4	36.75
60	937.0	36.89
65	941.7	37.08
70	945.5	37.23
75	950.3	37.41
80	955.7	37.63
85	961.4	37.85
90	968.6	38.14
95	980.4	38.60
97	987.6	38.88
98	992.5	39.08
99	999.7	39.36

Mean: 929.6 mm; 36.60 in.  
Standard deviation: 31.1 mm; 1.23 in.  
Coefficient of variation: 3.35%  
Range: 817.0 - 1025.0 mm; 32.17 - 40.35 in.  
Number of subjects: 1996

Check measure deviation: 8.8 mm; 0.9%

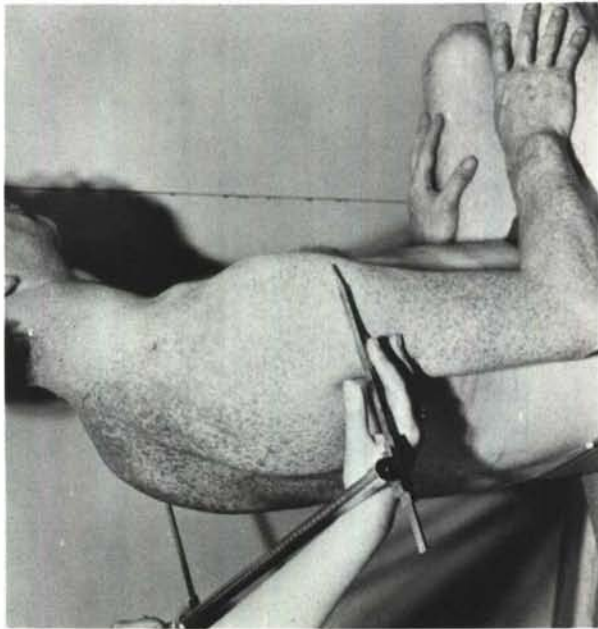
TABLE 69

REPEAT MEASURE USA TECHNIQUE -BIDELTOID BREADTH

Sitting erect with shoulders relaxed. Elbows held lightly against sides with hands on mid-thighs. Measurement between datum edges of anthropometer in light contact with maximum lateral protrusions of deltoid muscles.

PERCENTILE VALUES

%	mm	in.
1	420.3	16.55
2	426.8	16.80
3	429.9	16.93
5	435.6	17.15
10	442.7	17.43
15	447.0	17.60
20	450.7	17.74
25	454.3	17.89
30	457.9	18.03
35	460.5	18.13
40	463.6	18.25
45	465.8	18.34
50	469.2	18.47
55	471.2	18.55
60	474.7	18.69
65	477.8	18.81
70	480.8	18.93
75	484.3	19.06
80	488.1	19.22
85	491.5	19.35
90	496.5	19.55
95	503.5	19.82
97	507.5	19.98
98	514.1	20.24
99	520.0	20.47



Mean: 469.8 mm; 18.50 in.  
Standard deviation: 21.2 mm; 0.84 in.  
Coefficient of variation: 4.52%  
Range: 402.0 - 555.0 mm; 15.83 - 21.85 in.  
Number of subjects: 1995

Check measure deviation: 3.5 mm; 0.7%



TABLE 70

## REPEAT MEASURE USA TECHNIQUE - BUTTOCK-KNEE LENGTH, SITTING

Sitting erect, feet flat on floor. Measurement between datum edges of anthropometer in light contact with patella and rearmost protrusion of buttocks.

## PERCENTILE VALUES

%	mm	in.
1	548.5	21.59
2	554.5	21.83
3	559.4	22.02
5	564.6	22.23
10	574.0	22.60
15	579.7	22.82
20	584.9	23.03
25	589.5	23.21
30	593.1	23.35
35	596.5	23.49
40	599.6	23.60
45	602.7	23.73
50	606.3	23.87
55	609.7	24.01
60	613.1	24.14
65	617.0	24.29
70	620.5	24.43
75	624.6	24.59
80	628.7	24.75
85	633.2	24.93
90	639.9	25.19
95	650.0	25.59
97	656.5	25.85
98	660.8	26.01
99	669.3	26.35

Mean: 607.3 mm; 23.91 in.  
Standard deviation: 26.1 mm; 1.03 in.  
Coefficient of variation: 4.30%  
Range: 498.0 - 696.0 mm; 19.61 - 27.40 in.  
Number of subjects: 1997

Check measure deviation: 7.5 mm; 1.2%



## PERCENTILE VALUES

%	mm	in.
1	750.8	29.56
2	759.4	29.90
3	764.8	30.11
5	772.1	30.40
10	783.0	30.83
15	790.1	31.11
20	796.4	31.35
25	802.9	31.61
30	806.8	31.76
35	811.3	31.94
40	815.7	32.11
45	819.5	32.27
50	823.4	32.42
55	827.4	32.58
60	831.2	32.72
65	834.7	32.86
70	839.0	33.03
75	844.1	33.23
80	849.3	33.44
85	854.9	33.66
90	862.1	33.94
95	872.4	34.35
97	881.0	34.69
98	887.8	34.95
99	895.5	35.26

Mean: 823.5 mm; 32.42 in.  
Standard deviation: 30.8 mm; 1.21 in.  
Coefficient of variation: 3.74%  
Range: 727.0 - 919.0 mm; 28.62 - 36.18 in.  
Number of subjects: 2000

DEDUCED MEASURE

TABLE 71

## SITTING EYE HEIGHT

Sitting height less pupil to vertex.

TABLE 72  
EYE HEIGHT, STANDING

Stature less pupil to vertex.

PERCENTILE VALUES

%	mm	in.
1	1526.0	60.08
2	1541.0	60.67
3	1548.8	60.98
5	1560.7	61.44
10	1582.7	62.31
15	1596.6	62.86
20	1607.6	63.29
25	1620.0	63.78
30	1629.9	64.17
35	1637.4	64.47
40	1646.0	64.80
45	1654.0	65.12
50	1661.1	65.40
55	1668.9	65.71
60	1676.8	66.02
65	1683.4	66.27
70	1691.6	66.60
75	1701.2	66.98
80	1712.3	67.41
85	1725.1	67.92
90	1742.3	68.60
95	1764.5	69.47
97	1783.0	70.20
98	1795.0	70.67
99	1808.0	71.18

Mean: 1661.9 mm; 65.43 in.  
Standard deviation: 61.8 mm; 2.43 in.  
Coefficient of variation: 3.72%  
Range: 1407.0 - 1890.0 mm; 55.39 - 74.41 in.  
Number of subjects: 2000

DEDUCED MEASURE

TABLE 73  
SHOULDER HEIGHT, STANDING

Stature less (sitting height less shoulder height)

PERCENTILE VALUES

%	mm	in.
1	1374.0	54.09
2	1387.7	54.63
3	1395.6	54.94
5	1406.8	55.39
10	1428.5	56.24
15	1440.5	56.71
20	1454.2	57.25
25	1464.1	57.64
30	1473.9	58.03
35	1482.1	58.35
40	1488.8	58.61
45	1496.4	58.91
50	1502.3	59.15
55	1509.6	59.43
60	1517.9	59.76
65	1525.5	60.06
70	1533.4	60.37
75	1543.2	60.76
80	1552.7	61.13
85	1562.6	61.52
90	1579.5	62.19
95	1601.4	63.05
97	1616.0	63.62
98	1631.7	64.24
99	1646.3	64.82

Mean: 1504.1 mm; 59.22 in.  
Standard deviation: 58.9 mm; 2.32 in.  
Coefficient of variation: 3.91%  
Range: 1271.0 - 1716.0 mm; 50.04 - 67.56 in.  
Number of subjects: 2000

DEDUCED MEASURE

TABLE 74  
AXILLA-FINGERTIP LENGTH

Axilla height less fingertip height.

PERCENTILE VALUES

%	mm	in.
1	593.0	23.35
2	601.0	23.66
3	607.2	23.91
5	616.1	24.26
10	627.6	24.71
15	633.8	24.95
20	640.6	25.22
25	646.4	25.45
30	650.9	25.63
35	655.1	25.79
40	659.5	25.97
45	663.6	26.13
50	667.6	26.28
55	671.6	26.44
60	676.1	26.62
65	680.2	26.78
70	685.1	26.97
75	689.1	27.13
80	695.4	27.38
85	702.3	27.65
90	710.1	27.96
95	721.4	28.40
97	732.8	28.85
98	741.3	29.18
99	749.0	29.49

Mean: 668.7 mm; 26.33 in.  
Standard deviation: 33.0 mm; 1.30 in.  
Coefficient of variation: 4.94%  
Range: 555.0 - 795.0 mm; 21.85 - 31.30 in.  
Number of subjects: 1999

DEDUCED MEASURE

TABLE 75

## AXILLA - WRIST LENGTH

Axilla height less fingertip height less hand length (hand length is elbow fingertip length less elbow wrist length).

## PERCENTILE VALUES

%	mm	in.
1	409.4	16.12
2	418.6	16.48
3	424.0	16.69
5	430.0	16.93
10	440.8	17.36
15	447.4	17.62
20	452.9	17.83
25	457.8	18.02
30	461.4	18.17
35	465.6	18.33
40	469.2	18.47
45	473.1	18.62
50	476.5	18.76
55	480.2	18.91
60	484.1	19.06
65	487.7	19.20
70	491.3	19.34
75	495.6	19.51
80	500.5	19.70
85	505.2	19.89
90	514.7	20.26
95	524.9	20.67
97	532.0	20.95
98	536.7	21.13
99	544.3	21.43

Mean: 477.3 mm; 18.79 in.  
Standard deviation: 28.6 mm; 1.13 in.  
Coefficient of variation: 5.99%  
Range: 365.0 - 579.0 mm; 14.37 - 22.80 in.  
Number of subjects: 1997

DEDUCED MEASURE

TABLE 76

## HAND LENGTH

Elbow-fingertip length less elbow-wrist length.

## PERCENTILE VALUES

%	mm	in.
1	168.7	6.64
2	171.2	6.74
3	172.7	6.80
5	174.8	6.88
10	178.7	7.03
15	180.9	7.12
20	182.8	7.20
25	184.2	7.25
30	185.5	7.30
35	186.8	7.36
40	188.1	7.41
45	189.5	7.46
50	190.6	7.51
55	191.9	7.56
60	193.3	7.61
65	194.5	7.66
70	195.8	7.71
75	197.4	7.77
80	199.2	7.84
85	200.9	7.91
90	203.5	8.01
95	206.9	8.14
97	209.3	8.24
98	211.8	8.34
99	215.6	8.49

Mean: 191.4 mm; 7.53 in.  
Standard deviation: 9.8 mm; 0.39 in.  
Coefficient of variation: 5.13%  
Range: 157.0 - 229.0 mm; 6.18 - 9.02 in.  
Number of subjects: 1998

DEDUCED MEASURE

TABLE 77

## CERVICALE HEIGHT, SITTING

Sitting height less (stature less cervicale height).

## PERCENTILE VALUES

%	mm	in.
1	614.0	24.17
2	622.3	24.50
3	626.7	24.67
5	632.9	24.92
10	643.4	25.33
15	650.3	25.60
20	656.0	25.83
25	659.9	25.98
30	664.4	26.16
35	668.2	26.31
40	671.9	26.45
45	675.1	26.58
50	678.4	26.71
55	681.7	26.84
60	684.9	26.96
65	688.4	27.10
70	692.1	27.25
75	696.3	27.41
80	701.3	27.61
85	707.2	27.84
90	712.7	28.06
95	722.6	28.45
97	729.0	28.70
98	735.0	28.94
99	745.0	29.33

Mean: 678.9 mm; 26.73 in.  
Standard deviation: 27.2 mm; 1.07 in.  
Coefficient of variation: 4.01%  
Range: 587.0 - 772.0 mm; 23.11 - 30.39 in.  
Number of subjects: 1999

DEDUCED MEASURE



TABLE 78

CERVICALE-VERTEX LENGTH

Stature less cervicale height.

PERCENTILE VALUES		
%	mm	in.
1	225.0	8.86
2	228.7	9.00
3	231.3	9.10
5	234.3	9.22
10	239.2	9.42
15	242.2	9.54
20	245.1	9.65
25	247.2	9.73
30	249.4	9.82
35	251.4	9.90
40	253.2	9.97
45	254.9	10.03
50	256.6	10.10
55	258.1	10.16
60	260.1	10.24
65	261.6	10.30
70	263.6	10.38
75	265.8	10.46
80	268.3	10.56
85	270.7	10.66
90	274.5	10.81
95	279.6	11.01
97	283.0	11.14
98	286.0	11.26
99	292.6	11.52

Mean: 257.2 mm; 10.13 in.  
Standard deviation: 14.1 mm; 0.56 in.  
Coefficient of variation: 5.50%  
Range: 193.0 - 320.0 mm; 7.60 - 12.60 in.  
Number of subjects: 1999

DEDUCED MEASURE

TABLE 79

AXILLA - CERVICALE LENGTH

Cervicale height less axilla height.

PERCENTILE VALUES		
%	mm	in.
1	139.2	5.48
2	142.8	5.62
3	146.4	5.76
5	150.2	5.91
10	155.9	6.14
15	160.5	6.32
20	163.5	6.44
25	166.2	6.54
30	168.5	6.63
35	171.1	6.74
40	173.4	6.83
45	175.4	6.90
50	177.4	6.98
55	179.3	7.06
60	181.2	7.13
65	183.4	7.22
70	185.9	7.32
75	188.5	7.42
80	191.1	7.52
85	194.5	7.66
90	198.4	7.81
95	205.2	8.08
97	209.2	8.24
98	211.2	8.32
99	216.0	8.50

Mean: 177.9 mm; 7.00 in.  
Standard deviation: 16.7 mm; 0.66 in.  
Coefficient of variation: 9.39%  
Range: 111.0 - 249.0 mm; 4.37 - 9.80 in.  
Number of subjects: 1999

DEDUCED MEASURE

TABLE 80

CERVICALE - WAIST LENGTH  
SERIAL NOS. 1-1662

NB Waist located by subject at the pre-ferred height of the waist adjustment tabs on a flying coverall

Cervicale height less waist height.

PERCENTILE VALUES		
%	mm	in.
1	380.5	14.98
2	389.0	15.32
3	392.5	15.45
5	399.9	15.74
10	410.7	16.17
15	416.4	16.39
20	421.3	16.59
25	424.9	16.73
30	429.0	16.89
35	432.7	17.04
40	436.0	17.17
45	439.7	17.31
50	442.8	17.43
55	446.2	17.57
60	449.5	17.70
65	453.2	17.84
70	457.0	17.99
75	462.0	18.19
80	467.1	18.39
85	473.6	18.64
90	479.9	18.89
95	489.6	19.27
97	494.6	19.47
98	497.7	19.59
99	508.5	20.02

Mean: 444.3 mm; 17.49 in.  
Standard deviation: 27.3 mm; 1.07 in.  
Coefficient of variation: 6.13%  
Range: 366.0 - 541.0 mm; 14.41 - 21.30 in.  
Number of subjects: 1651

DEDUCED MEASURE

TABLE 81

CERVICALE - WAIST LENGTH  
SERIAL NOS. 1663-2018

NB Waist located at natural  
waist indent

Cervicale height less weight height.

## PERCENTILE VALUES

%	mm	in.
1	347.0	13.66
2	352.0	13.86
3	355.4	13.99
5	361.5	14.23
10	369.3	14.54
15	374.4	14.74
20	377.9	14.88
25	382.0	15.04
30	385.2	15.16
35	387.3	15.25
40	390.3	15.37
45	392.5	15.45
50	394.3	15.52
55	397.6	15.65
60	399.8	15.74
65	403.2	15.87
70	405.5	15.96
75	407.9	16.06
80	412.1	16.22
85	416.5	16.40
90	421.5	16.59
95	425.9	16.77
97	428.9	16.88
98	436.0	17.17
99	442.5	17.42

Mean: 395.5 mm; 15.57 in.  
Standard deviation: 20.4 mm; 0.80 in.  
Coefficient of variation: 5.16%  
Range: 335.0 - 489.0 mm; 13.19 - 19.25 in.  
Number of subjects: 348

DEDUCED MEASURE

TABLE 82

CERVICALE - CROTCH LENGTH

Cervicale height less crotch height.

## PERCENTILE VALUES

%	mm	in.
1	599.5	23.60
2	607.8	23.93
3	611.6	24.08
5	618.4	24.35
10	628.2	24.73
15	634.7	24.99
20	639.3	25.17
25	643.8	25.35
30	648.6	25.54
35	652.6	25.69
40	656.1	25.83
45	659.9	25.98
50	663.2	26.11
55	666.8	26.25
60	670.3	26.39
65	673.9	26.53
70	677.4	26.67
75	681.4	26.83
80	686.0	27.01
85	691.6	27.23
90	698.4	27.50
95	709.8	27.94
97	716.3	28.20
98	721.0	28.39
99	726.5	28.60

Mean: 663.7 mm; 26.13 in.  
Standard deviation: 27.5 mm; 1.08 in.  
Coefficient of Variation: 4.14%  
Range: 556.0 - 752.0 mm; 21.89 - 29.61 in.  
Number of subjects: 1999

DEDUCED MEASURE

TABLE 83

NASION TO MENTON, VERTICAL

Menton to vertex less nasion to vertex.

## PERCENTILE VALUES

%	mm	in.
1	105.5	4.15
2	108.5	4.27
3	109.8	4.32
5	111.5	4.39
10	114.2	4.50
15	115.8	4.56
20	117.0	4.61
25	117.9	4.64
30	118.7	4.67
35	119.7	4.71
40	120.7	4.75
45	121.6	4.79
50	122.4	4.82
55	123.4	4.86
60	124.4	4.90
65	125.3	4.93
70	126.2	4.97
75	127.3	5.01
80	128.6	5.06
85	130.1	5.12
90	132.2	5.20
95	134.8	5.31
97	136.3	5.37
98	138.1	5.44
99	140.1	5.52

Mean: 123.2 mm; 4.85 in.  
Standard deviation: 7.2 mm; 0.28 in.  
Coefficient of variation: 5.86%  
Range: 86.0 - 155.0 mm; 3.39 - 6.10 in.  
Number of subjects: 2000

DEDUCED MEASURE

TABLE 84

TRAGION TO MENTON, HORIZONTAL

Menton to back of head less tragon to back of head.

DEDUCED MEASURE

Mean: 98.4 mm; 3.87 in.  
Standard deviation: 9.1 mm; 0.36 in.  
Coefficient of variation: 9.20%  
Range: 65.0 - 144.0 mm; 2.56 - 5.67 in.  
Number of subjects: 1998

TABLE 85

TRAGION TO MENTON, VERTICAL

Menton to vertex less tragon to vertex.

DEDUCED MEASURE

Mean: 99.2 mm; 3.91 in.  
Standard deviation: 9.5 mm; 0.38 in.  
Coefficient of variation: 9.62%  
Range: 66.0 - 142.0 mm; 2.60 - 5.59 in.  
Number of subjects: 2000

TABLE 86

TRAGION TO BROW RIDGE, HORIZONTAL

Head length less tragon to back of head.

DEDUCED MEASURE

Mean: 97.5 mm; 3.84 in.  
Standard deviation: 6.5 mm; 0.25 in.  
Coefficient of variation: 6.62%  
Range: 62.0 - 119.0 mm; 2.44 - 4.69 in.  
Number of subjects: 2000

PERCENTILE VALUES

%	mm	in.
1	76.7	3.02
2	79.1	3.11
3	80.5	3.17
5	82.9	3.26
10	86.2	3.39
15	88.2	3.47
20	90.3	3.55
25	91.8	3.62
30	93.3	3.67
35	94.9	3.74
40	95.9	3.77
45	97.0	3.82
50	98.0	3.86
55	99.2	3.90
60	100.0	3.94
65	101.4	3.99
70	102.7	4.04
75	104.0	4.09
80	105.5	4.15
85	107.1	4.22
90	109.2	4.30
95	112.3	4.42
97	114.2	4.50
98	115.7	4.56
99	117.4	4.62

PERCENTILE VALUES

%	mm	in.
1	76.2	3.00
2	78.8	3.10
3	81.2	3.20
5	83.4	3.28
10	86.7	3.41
15	89.0	3.50
20	90.6	3.57
25	92.4	3.64
30	93.8	3.69
35	95.0	3.74
40	96.2	3.79
45	97.5	3.84
50	98.7	3.89
55	99.9	3.93
60	101.1	3.98
65	102.3	4.03
70	103.7	4.08
75	105.1	4.14
80	106.7	4.20
85	108.5	4.27
90	110.9	4.37
95	114.6	4.51
97	116.8	4.60
98	118.0	4.65
99	120.0	4.72

PERCENTILE VALUES

%	mm	in.
1	80.7	3.18
2	83.4	3.28
3	84.5	3.33
5	86.4	3.40
10	88.9	3.50
15	90.4	3.56
20	91.7	3.61
25	92.9	3.66
30	93.9	3.70
35	95.0	3.74
40	95.7	3.77
45	96.4	3.80
50	97.2	3.83
55	97.9	3.86
60	98.8	3.89
65	99.6	3.92
70	100.5	3.96
75	101.4	3.99
80	102.3	4.03
85	103.5	4.07
90	105.0	4.13
95	107.1	4.22
97	108.6	4.28
98	110.2	4.34
99	111.7	4.40



TABLE 87

## TRAGION TO PUPIL, VERTICAL

Tragion to vertex less pupil to vertex.

PERCENTILE VALUES		
%	mm	in.
1	-1.0	-0.04
2	1.7	0.07
3	3.0	0.12
5	4.5	0.18
10	7.1	0.28
15	8.9	0.35
20	10.3	0.41
25	11.6	0.46
30	12.8	0.50
35	14.0	0.55
40	15.2	0.60
45	16.3	0.64
50	17.4	0.68
55	18.5	0.73
60	19.6	0.77
65	20.6	0.81
70	21.6	0.85
75	22.7	0.90
80	24.2	0.95
85	25.6	1.01
90	27.4	1.08
95	29.9	1.18
97	31.9	1.26
98	33.7	1.32
99	36.1	1.42

Mean: 17.8 mm; 0.70 in.  
 Standard deviation: 7.9 mm; 0.31 in.  
 Coefficient of variation: 44.69%  
 Range: -21.0 - 44.0 mm; -0.83 - 1.73 in.  
 Number of subjects: 1992

DEDUCED MEASURE

TABLE 88

## TRAGION TO NASION, VERTICAL

Tragion to vertex less nasion to vertex.

PERCENTILE VALUES		
%	mm	in.
1	-2.0	-0.08
2	4.4	0.17
3	6.1	0.24
5	8.2	0.32
10	11.3	0.44
15	13.3	0.52
20	15.3	0.60
25	17.0	0.67
30	18.4	0.72
35	19.8	0.78
40	21.3	0.84
45	22.6	0.89
50	23.8	0.94
55	24.8	0.97
60	25.9	1.02
65	27.4	1.08
70	28.8	1.13
75	30.1	1.18
80	31.7	1.25
85	33.2	1.31
90	35.3	1.39
95	38.7	1.52
97	40.9	1.61
98	42.4	1.67
99	45.1	1.78

Mean: 24.0 mm; 0.94 in.  
 Standard deviation: 9.4 mm; 0.37 in.  
 Coefficient of variation: 39.12%  
 Range: -17.0 - 56.0 mm; -0.67 - 2.20 in.  
 Number of subjects: 1997

DEDUCED MEASURE

TABLE 89

TABLE	MEASUREMENT	MEAN	MIN	PERCENTILE				MAX
				1st	3rd	97th	99th	
1.	Weight (Kg)	75	51	56	59	92	97	109
2.	Age (Years)	31	19	20	21	43	45	46
3.	Functional Reach	802	678	722	736	871	889	946
4.	Buttock-Knee Length	608	515	550	558	659	672	693
5.	Knee Height	559	453	505	514	610	623	662
6.	Sitting Height	936	824	865	876	992	1007	1026
7.	Shoulder Height	666	577	604	614	715	727	754
8.	Acromial Height	612	504	549	558	666	681	713
9.	Elbow Rest Height	248	164	188	200	294	306	323
10.	Bideltoid Breadth	466	396	419	427	505	514	547
11.	Stool Height	424	333	366	376	469	471	473
12.	Biacromial Breadth	407	342	359	370	442	452	486
13.	Hip Breadth	368	310	324	332	406	415	436
14.	Cervicale Height	1517	1285	1392	1410	1631	1661	1749
15.	Stature	1774	1514	1638	1661	1893	1924	2009
16.	Axilla Height	1339	1121	1218	1238	1442	1478	1543
17.	Waist Height (Serial Nos. 1-1662)	1074	884	957	980	1178	1200	1302
18.	Waist Height (Serial Nos. 1663-2013)	1117	973	1009	1023	1206	1227	1288
19.	Fingertip Height	671	558	591	606	734	749	790
20.	Crotch Height	854	700	758	775	936	960	1011
21.	Span	1828	1494	1665	1692	1965	2014	2096
22.	Inter-Elbow Span	991	790	894	909	1070	1088	1152
23.	Elbow-Fingertip Length	480	401	432	442	520	531	568
24.	Elbow-Wrist Length	288	244	254	261	316	323	346
25.	Ankle Circumference	225	185	198	203	250	255	270
26.	Calf Circumference	367	300	319	327	408	416	440
27.	Thigh Circumference	570	447	480	496	642	659	701
28.	Buttock Circumference	989	813	873	895	1085	1108	1183
29.	Waist Circumference (Serial Nos. 1-1662)	857	668	708	735	995	1020	1120
30.	Waist Circumference (Serial Nos. 1663-2013)	829	660	693	720	974	1011	1033
31.	Chest Circumference	972	822	846	870	1087	1111	1245
32.	Neck Circumference	382	332	343	351	414	421	448
33.	Waist to Waist Over Shoulder (Serial Nos. 1-1662)	985	827	867	890	1088	1111	1177
34.	Waist to Waist Over Shoulder (Serial Nos. 1663-2013)	895	763	792	817	967	982	1065
35.	Crotch Length (Serial Nos. 1-1662)	641	461	518	546	743	766	885
36.	Crotch Length (Serial Nos. 1663-2013)	735	597	633	654	822	858	917
37.	Vertical Trunk Circumference (Mean)	1625	1412	1480	1504	1747	1774	1852
38.	Wrist Circumference	174	146	154	157	193	197	210
39.	Elbow, Fully Bent, Circumference	343	282	303	310	376	384	413
40.	Knee, Fully Bent, Circumference	446	378	398	406	485	495	516
41.	Ball of Foot Circumference	250	214	223	228	272	278	290
42.	Instep-Sole Circumference	247	214	222	228	268	273	288
43.	Heel-Instep Circumference	325	284	294	300	352	359	378
44.	Foot Length	266	219	239	244	289	297	309
45.	Foot Breadth	95	83	86	87	104	106	113
46.	Head Circumference	577	530	547	551	603	608	624
47.	Bitragion-Coronal Arc	353	311	324	330	377	385	404
48.	Head Breadth	158	140	145	147	168	171	180

TABLE 89 (Continued)

TABLE	MEASUREMENT	MEAN	MIN	PERCENTILE				MAX
				1st	3rd	97th	99th	
49.	Bitracion Diameter	139	122	127	129	149	152	157
50.	Maximum Head Diagonal From Menton	262	237	245	247	277	280	286
51.	Menton to Back of Head	200	160	174	179	219	224	240
52.	Menton to Vertex	230	191	204	210	248	252	262
53.	Tracion to Back of Head	101	78	86	88	114	118	141
54.	Tracion to Vertex	130	95	114	118	141	145	156
55.	Pupil to Vertex	113	85	92	97	128	130	138
56.	Nasion to Vertex	106	75	84	88	124	128	136
57.	Head Length	199	178	183	186	210	213	220
58.	Buttock-Heel Length	1090	889	975	998	1188	1211	1276
59.	Biceps Skinfold	5	2	2	3	10	12	19
60.	Suprailiac Skinfold	9	3	4	4	16	19	32
61.	Triceps Skinfold	11	3	4	5	20	22	26
62.	Subscapular Skinfold	13	5	6	7	25	29	34
63.	Vertical Functional Reach	1384	1214	1266	1281	1478	1515	1569
64.	Thigh Clearance Height	158	128	132	137	180	191	227
65.	Elbow-Functional Reach	420	369	376	384	458	464	496
66.	Stomach Depth	242	188	192	203	287	306	328
67.	Stature (USA Technique)	1770	1509	1631	1655	1890	1920	1999
68.	Sitting Height (USA Technique)	930	817	855	868	988	1000	1025
69.	Bideltoid Breadth (USA Technique)	470	402	420	430	508	520	555
70.	Buttock-Knee Length (USA Technique)	607	498	549	559	657	669	696
71.	Sitting Eye Height	824	727	751	765	881	896	919
72.	Eye Height, Standing							
73.	Shoulder Height, Standing							
74.	Axilla-Fingertip Length	669	555	593	607	733	749	795
75.	Axilla-Wrist Length	477	365	409	424	532	544	579
76.	Hand Length	191	157	169	173	209	216	229
77.	Cervicale Height, Sitting	679	587	614	627	729	745	772
78.	Cervicale-Vertex Length	257	193	225	231	283	293	320
79.	Axilla-Cervicale Length	178	111	139	146	209	216	249
80.	Cervicale-Waist Length (Serial Nos. 1-1662)	444	366	381	393	495	509	541
81.	Cervicale-Waist Length (Serial Nos. 1663-2013)	396	335	347	355	429	443	489
82.	Cervicale-Crotch Length	664	556	600	612	716	727	752
83.	Nasion to Menton, Vertical	123	86	106	110	136	140	155
84.	Tracion to Menton, Horizontal	98	65	77	81	114	117	144
85.	Tracion to Menton, Vertical	99	66	76	81	117	120	142
86.	Tracion to Brow Ridge, Horizontal	98	62	81	85	109	112	119
87.	Tracion to Pupil, Vertical	18	-21	-1	3	32	36	44
88.	Tracion to Nasion, Vertical	24	-17	-2	6	41	45	56

Summary of Measurements

NB All dimensions given in mm



Serial No	Serial No	Serial No	Serial No
NAME	NAME	NAME	NAME
RANK	RANK	RANK	RANK
Initial or Check Measure	Initial or Check Measure	Initial or Check Measure	Initial or Check Measure
SERVICE NO	SERVICE NO	SERVICE NO	SERVICE NO
DATE MEASURED	DATE MEASURED	DATE MEASURED	DATE MEASURED
DATE OF BIRTH	DATE OF BIRTH	DATE OF BIRTH	DATE OF BIRTH
AGE	AGE	AGE	AGE
MEDICAL CATEGORY A G Z	MEDICAL CATEGORY A G Z	MEDICAL CATEGORY A G Z	MEDICAL CATEGORY A G Z
CURRENT AIRCRAFT	CURRENT AIRCRAFT	CURRENT AIRCRAFT	CURRENT AIRCRAFT
CREW DUTY	CREW DUTY	CREW DUTY	CREW DUTY
HANDINESS	HANDINESS	HANDINESS	HANDINESS
PLACE OF BIRTH	PLACE OF BIRTH	PLACE OF BIRTH	PLACE OF BIRTH
Subject	Subject	Subject	Subject
Mother	Mother	Mother	Mother
Father	Father	Father	Father
Mother's mother	Mother's mother	Mother's mother	Mother's mother
Mother's father	Mother's father	Mother's father	Mother's father
Father's mother	Father's mother	Father's mother	Father's mother
Father's father	Father's father	Father's father	Father's father
RACE	RACE	RACE	RACE
Subject	Subject	Subject	Subject
Mother	Mother	Mother	Mother
Father	Father	Father	Father
Mother's mother	Mother's mother	Mother's mother	Mother's mother
Mother's father	Mother's father	Mother's father	Mother's father
Father's mother	Father's mother	Father's mother	Father's mother
Father's father	Father's father	Father's father	Father's father
EMPLOYMENT	EMPLOYMENT	EMPLOYMENT	EMPLOYMENT
Mother	Mother	Mother	Mother
Father	Father	Father	Father
IMPRESSION OF SOMATOTYPE	IMPRESSION OF SOMATOTYPE	IMPRESSION OF SOMATOTYPE	IMPRESSION OF SOMATOTYPE
MEASURER	MEASURER	MEASURER	MEASURER
74 Vertical functional reach	74 Vertical functional reach	74 Vertical functional reach	74 Vertical functional reach
75 Thigh clearance height	75 Thigh clearance height	75 Thigh clearance height	75 Thigh clearance height
76 Elbow-functional reach	76 Elbow-functional reach	76 Elbow-functional reach	76 Elbow-functional reach
77 Stomach depth - sitting	77 Stomach depth - sitting	77 Stomach depth - sitting	77 Stomach depth - sitting

Fig.1 Data proforma

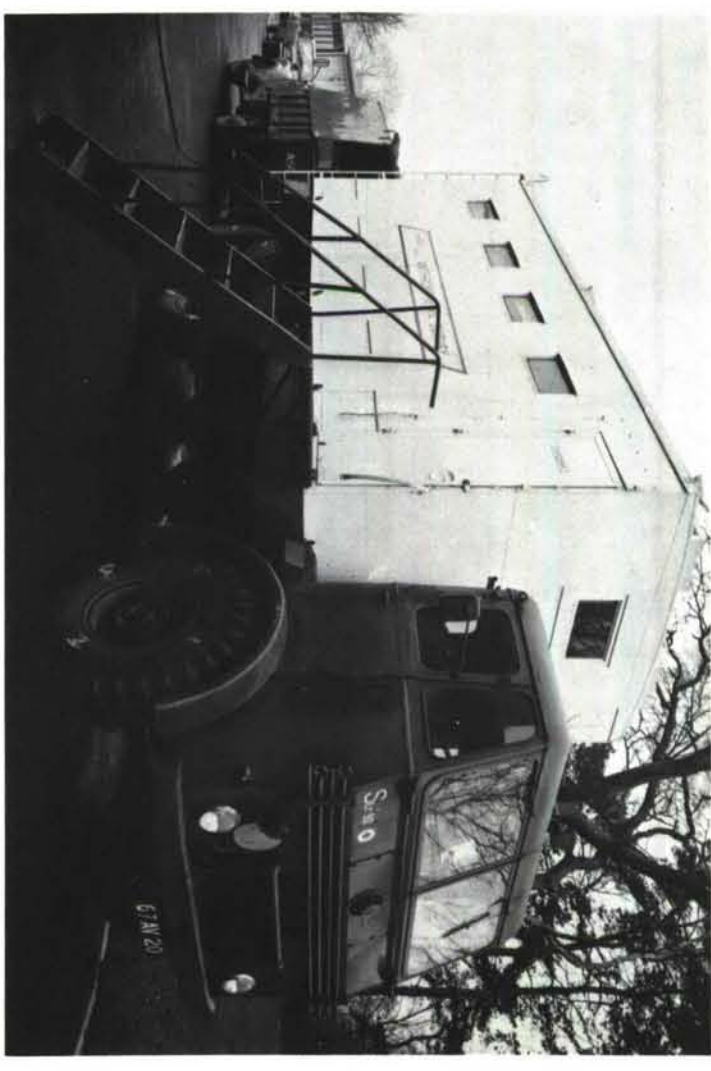


Fig.2 Mobile measuring laboratory

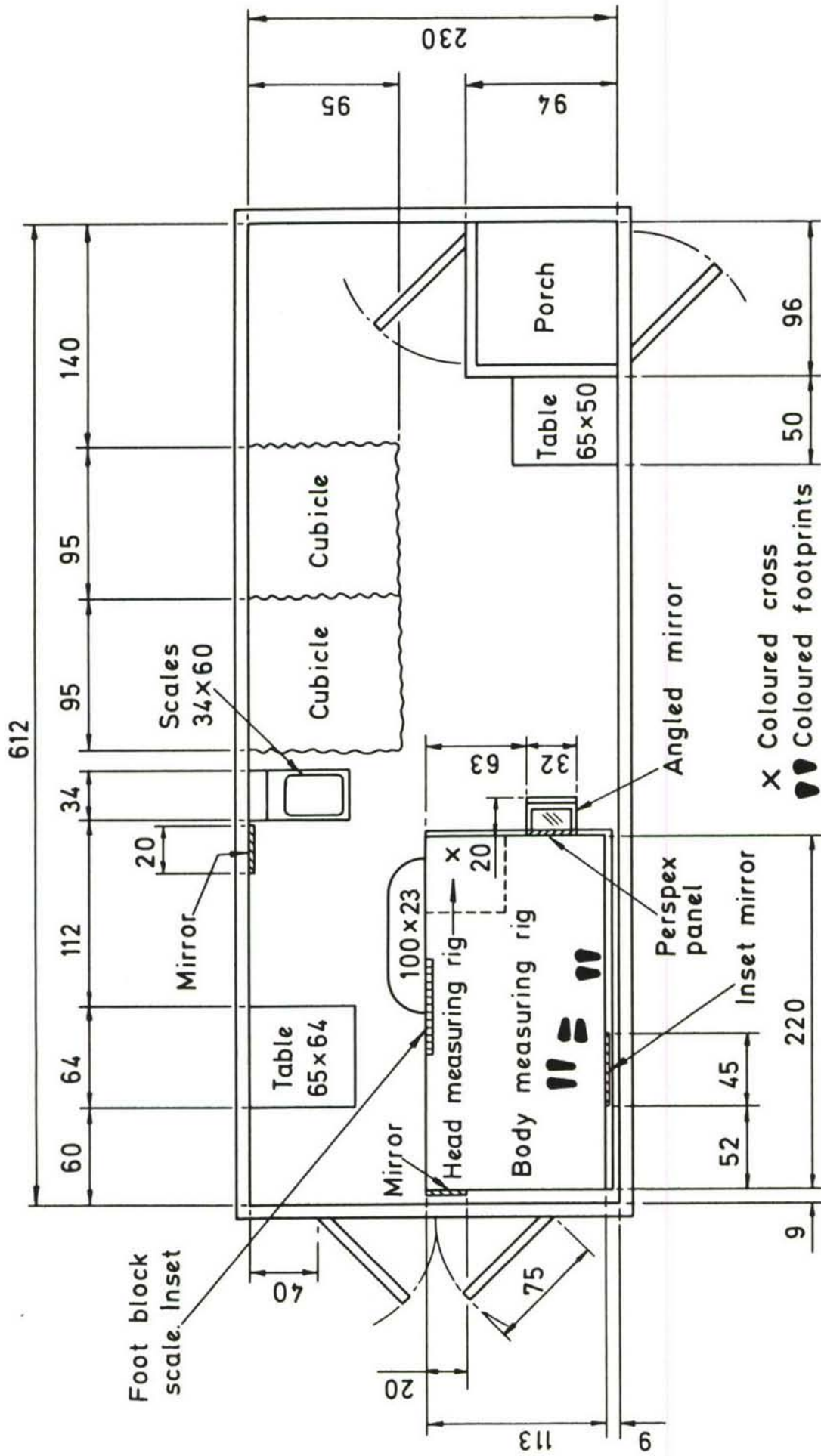


Fig.3 Plan of mobile laboratory



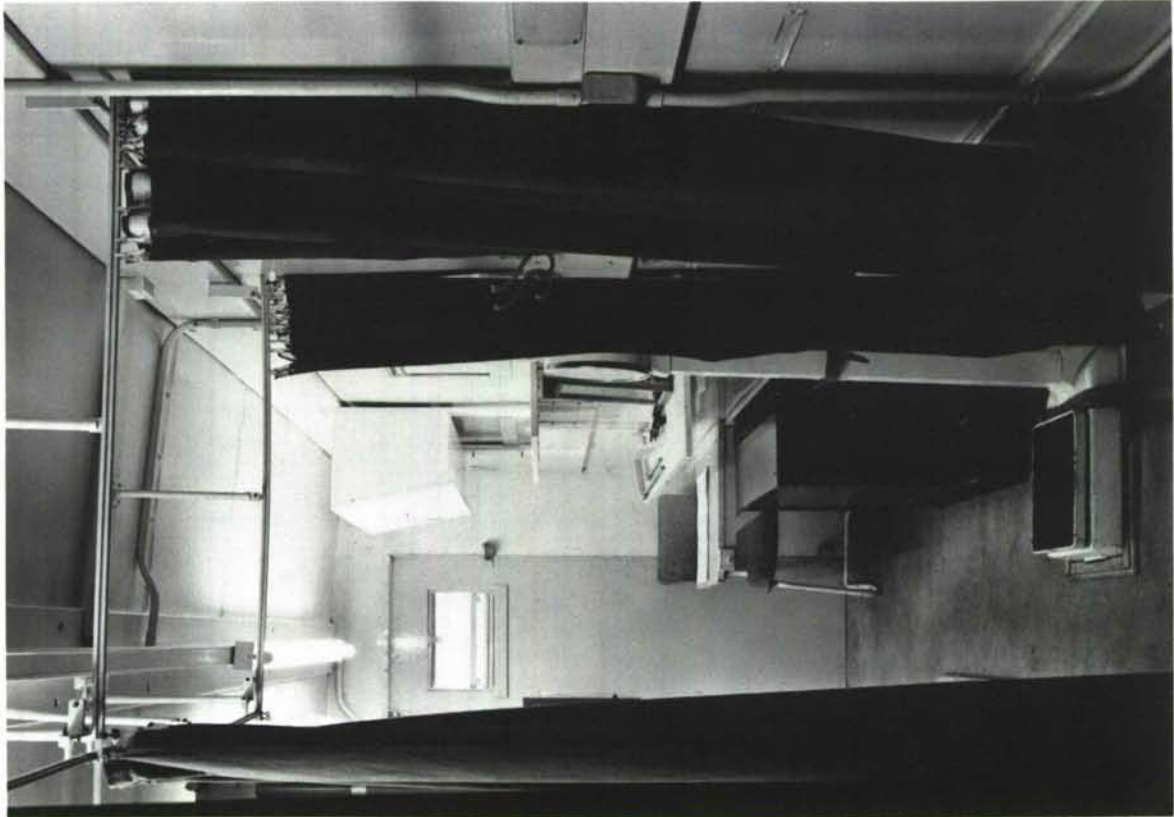


Fig.4 Interior of laboratory showing changing cubicles, weighing machine and recorder's table and chair

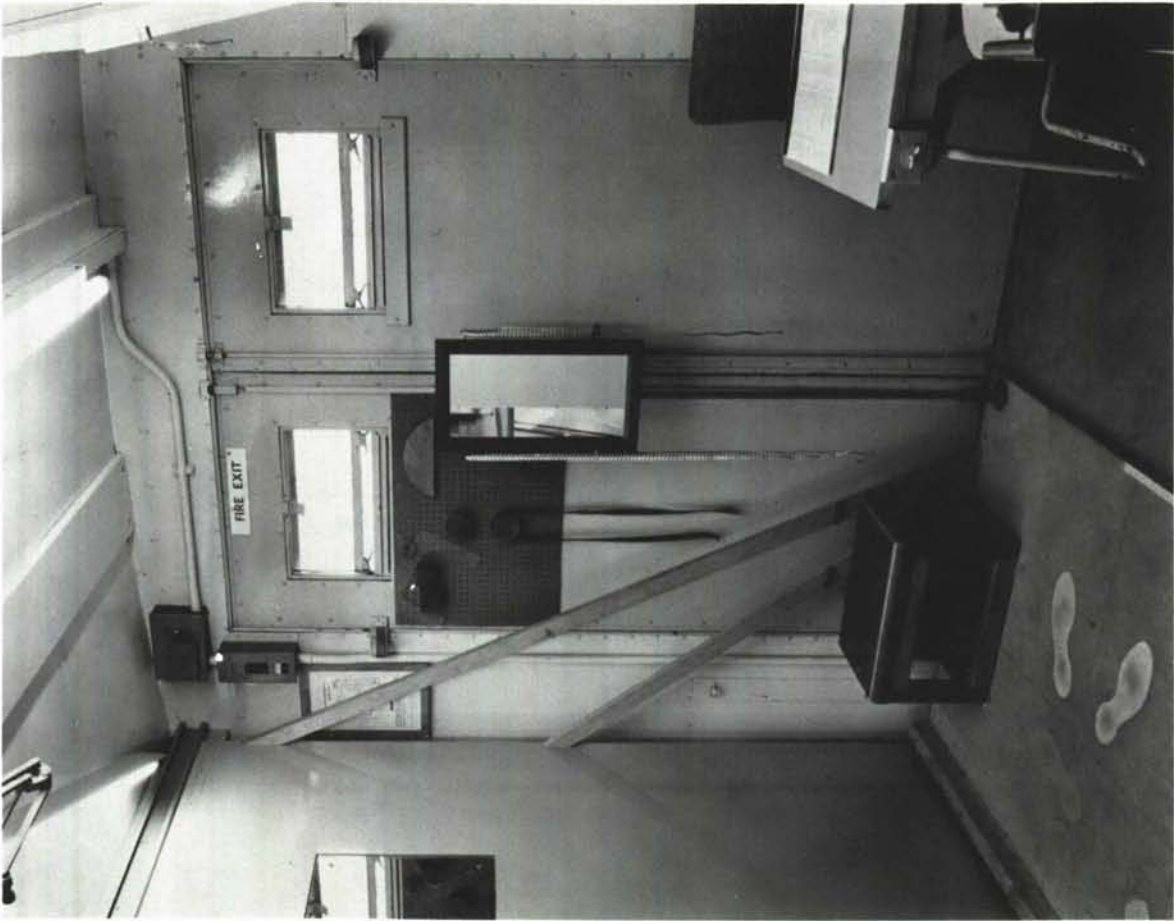


Fig.5 Interior of laboratory showing mirror set in the back wall of the rig and mirror mounted on a stand for use when taking measurements in the head measuring rig

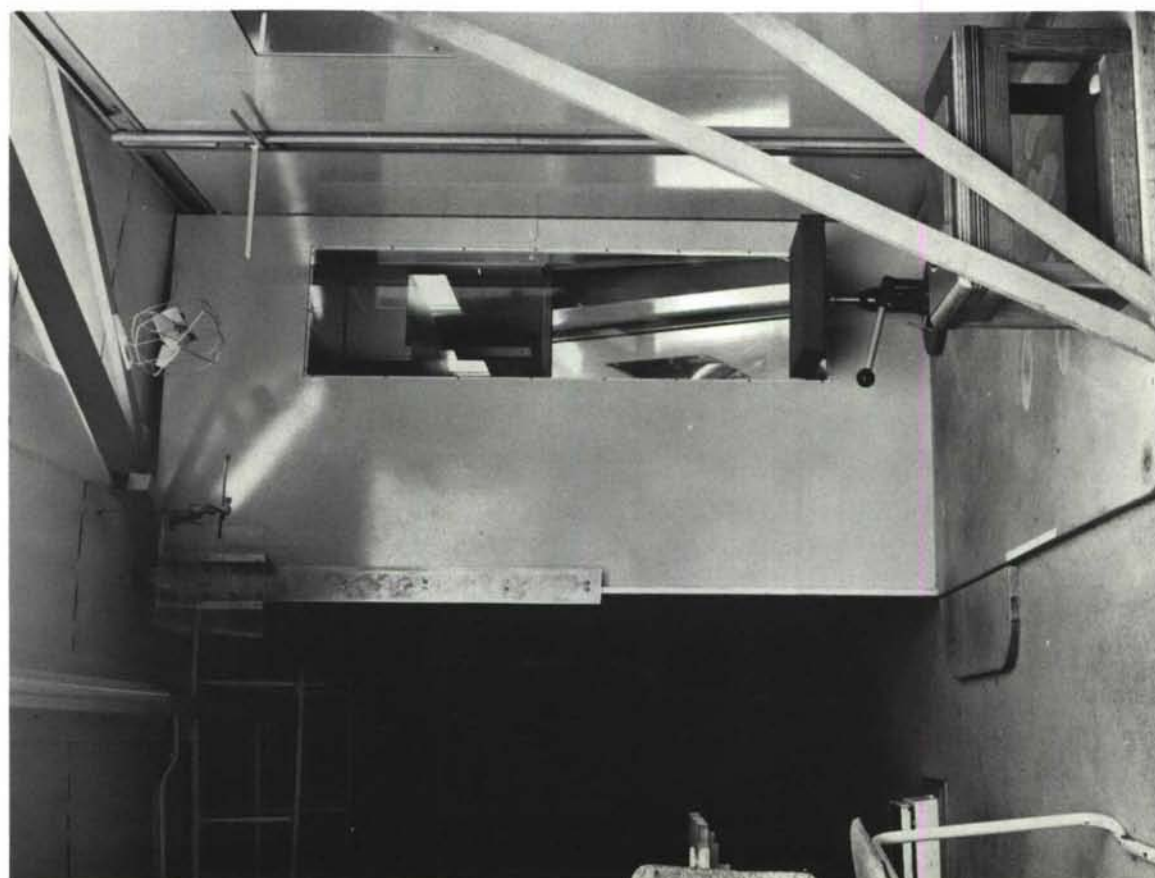


Fig.6 Body measuring rig showing mirror behind perspex panel set in the end wall

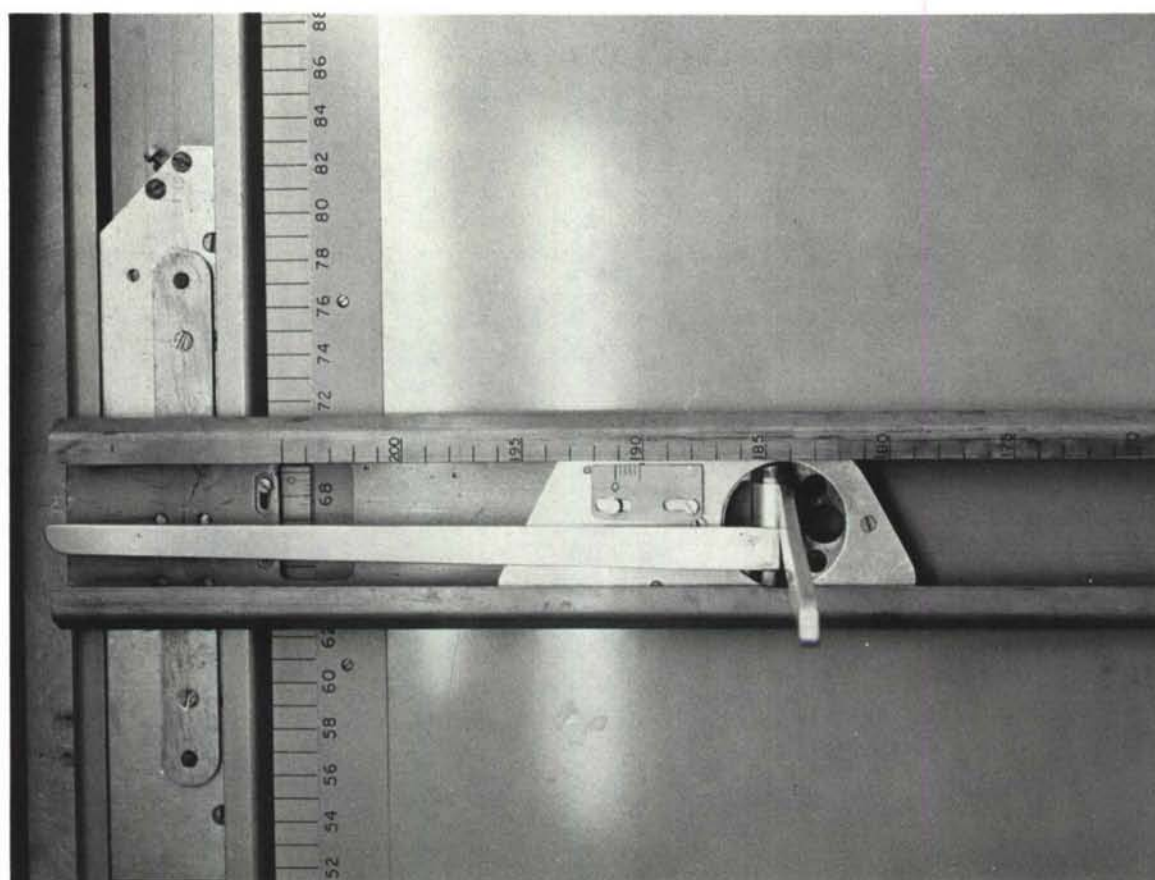


Fig.7 Measuring probes in position for taking measurements from end wall



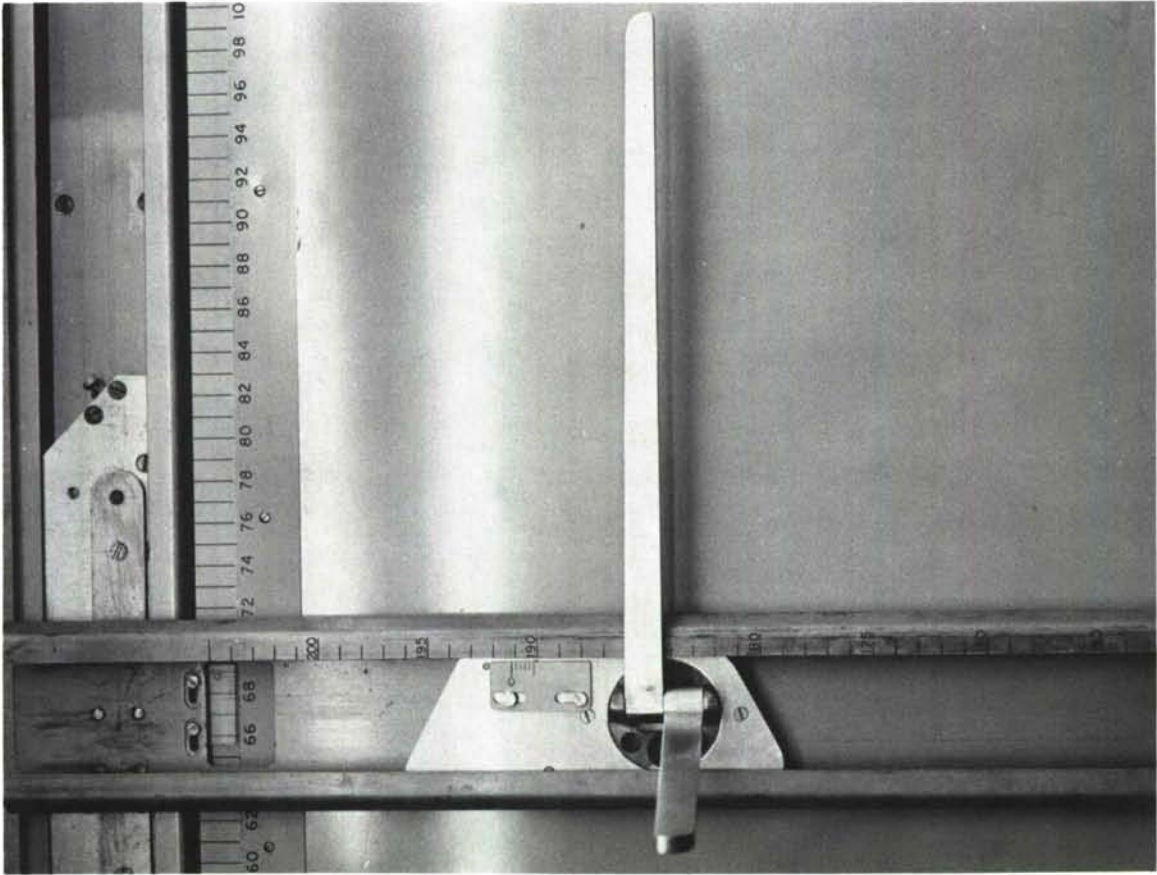


Fig.8 Measuring probes in position for taking measurements from floor

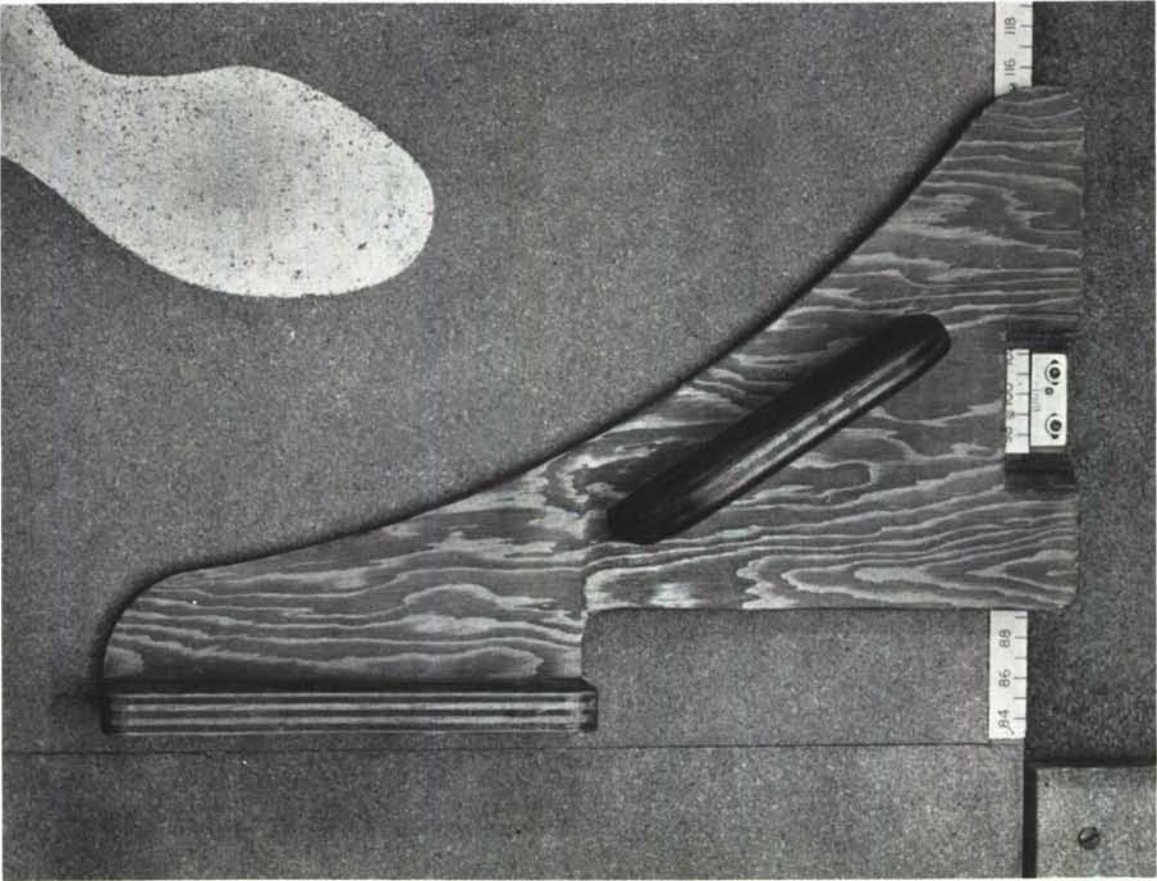


Fig.9 Sliding block, for measuring buttock-heel length, positioned on scale  
inset on floor of measuring rig



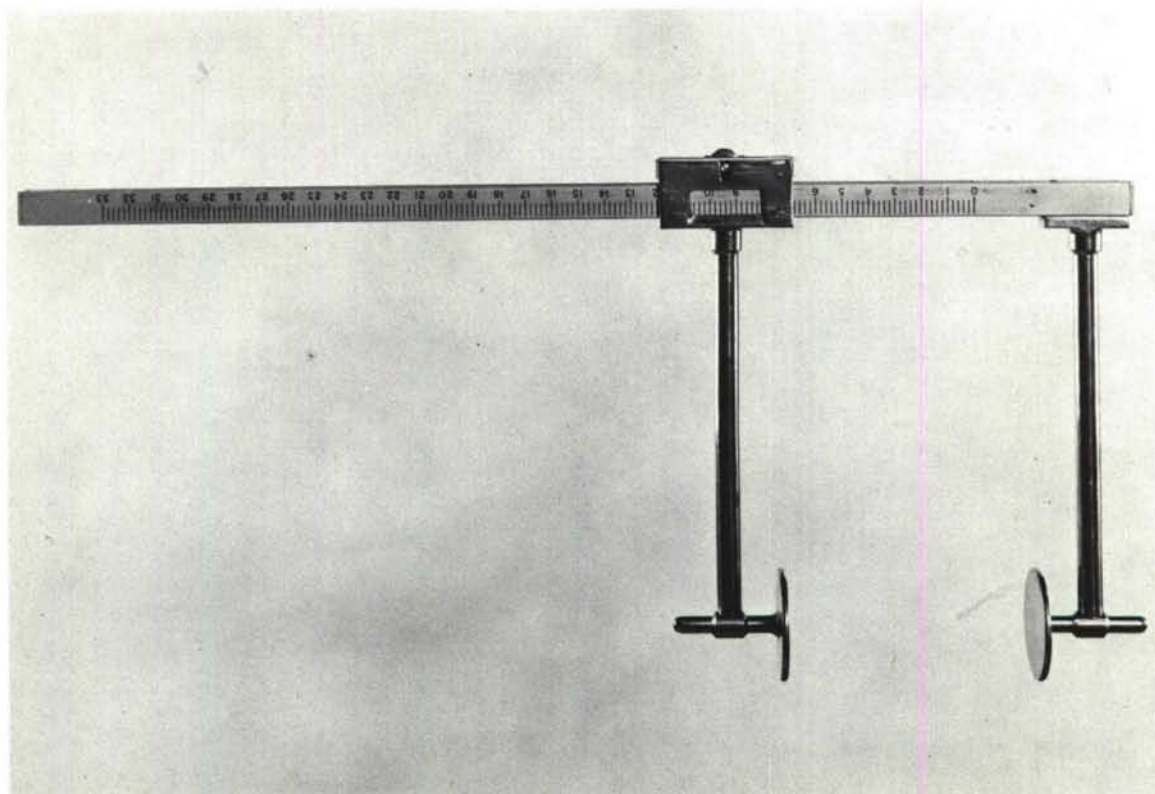


Fig.11 Head caliper

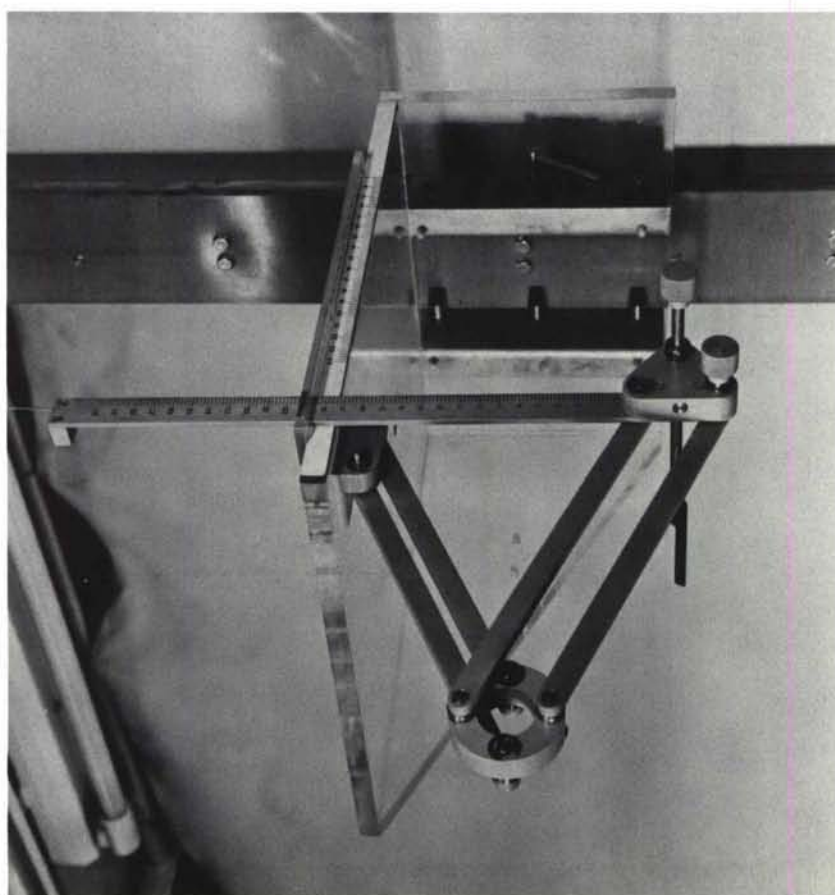


Fig.10 Head measuring rig

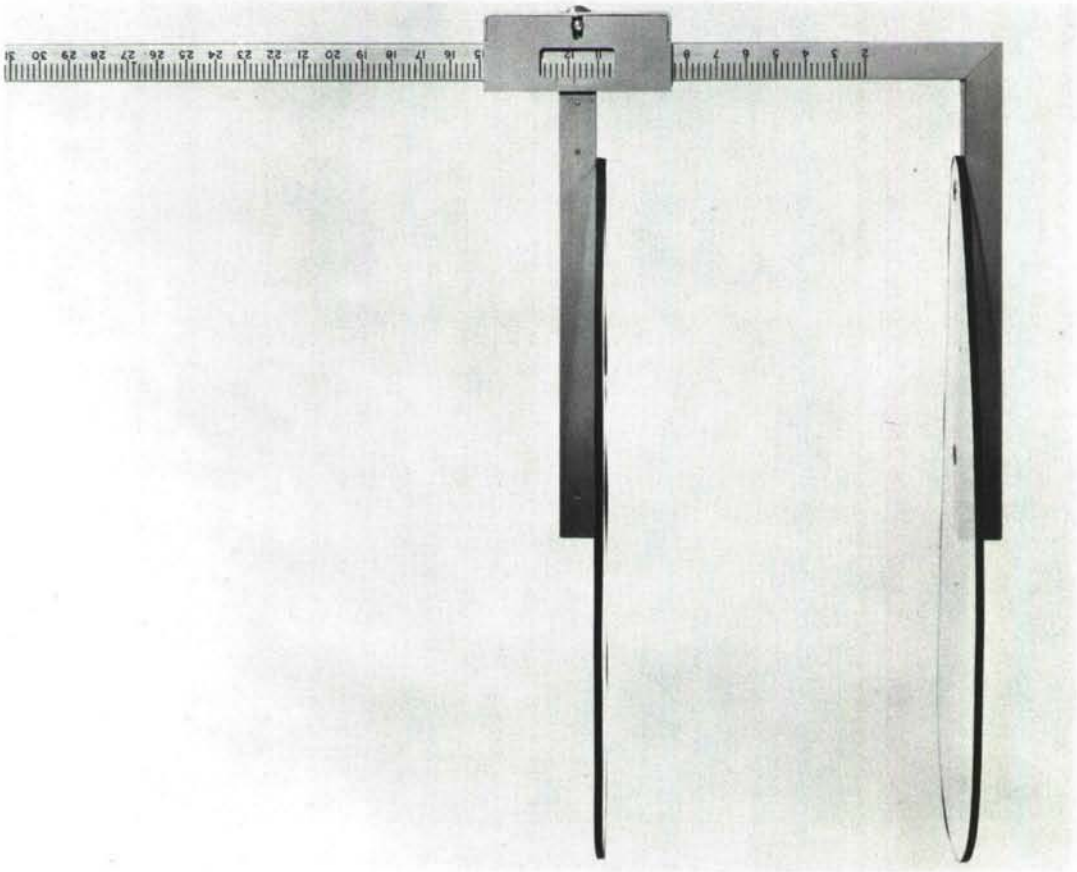


Fig.12 Body width caliper



Fig.13 Foot measuring box

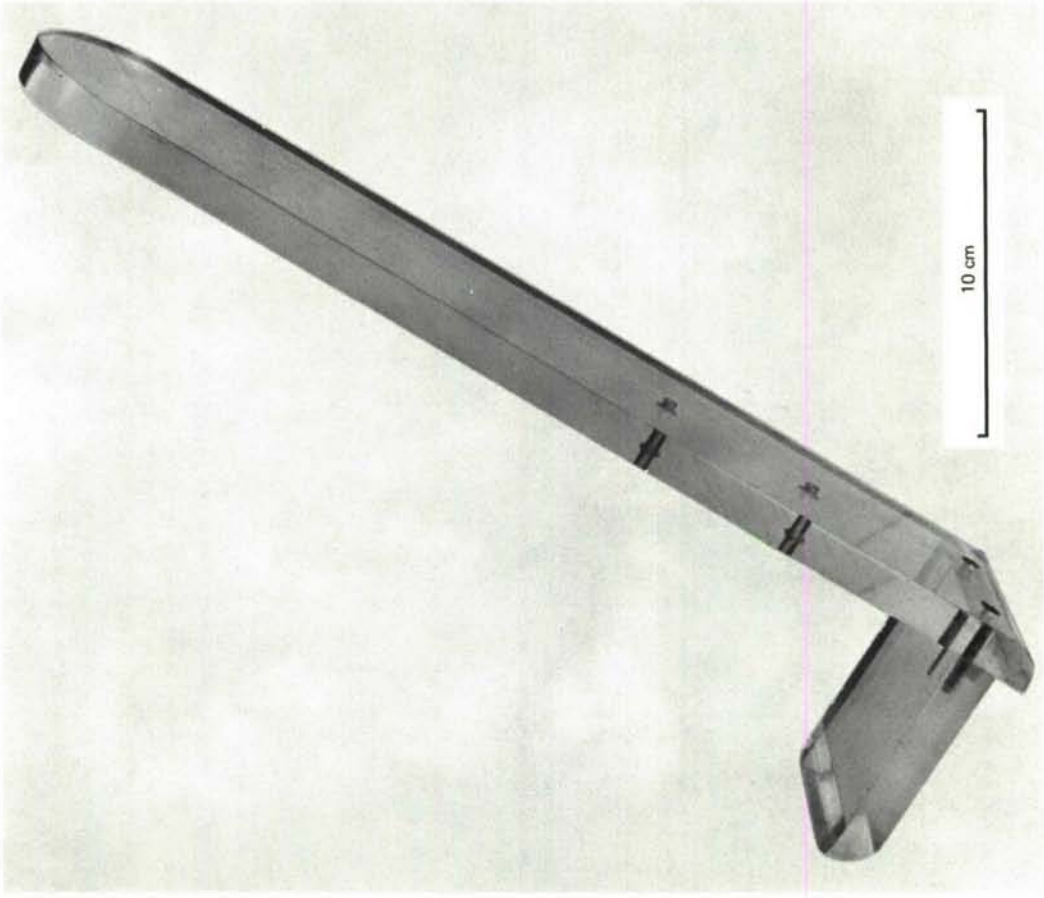


Fig.15 Knee block

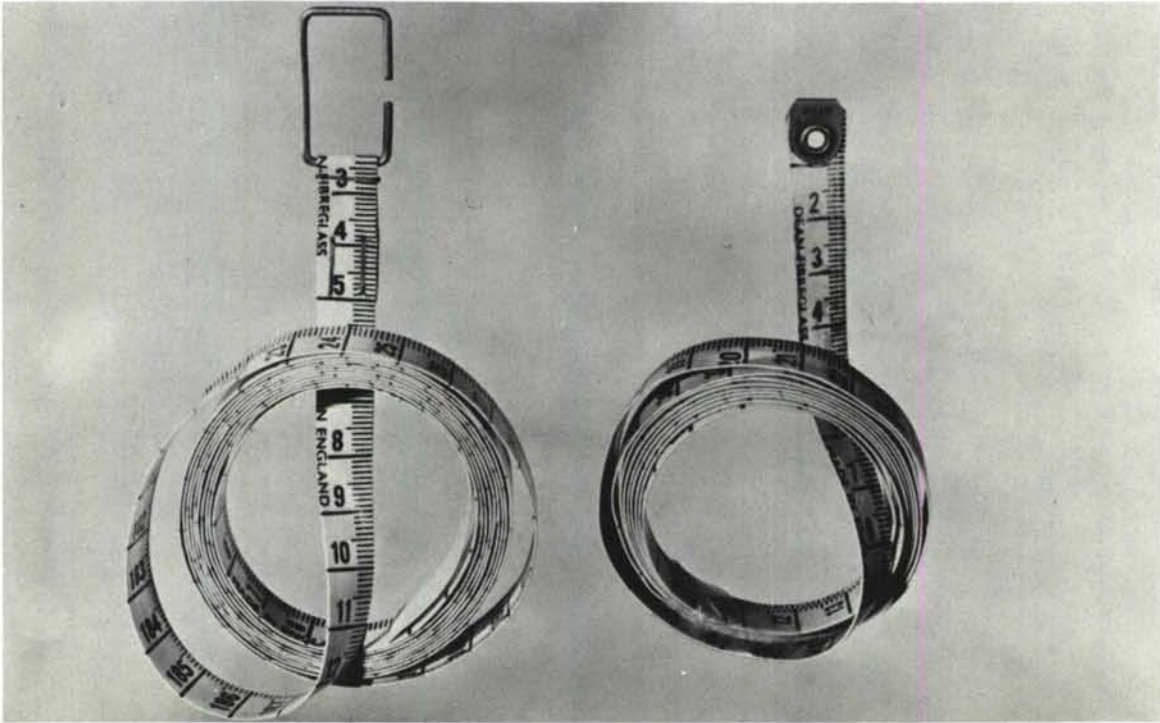


Fig.14 Glass cloth tapes



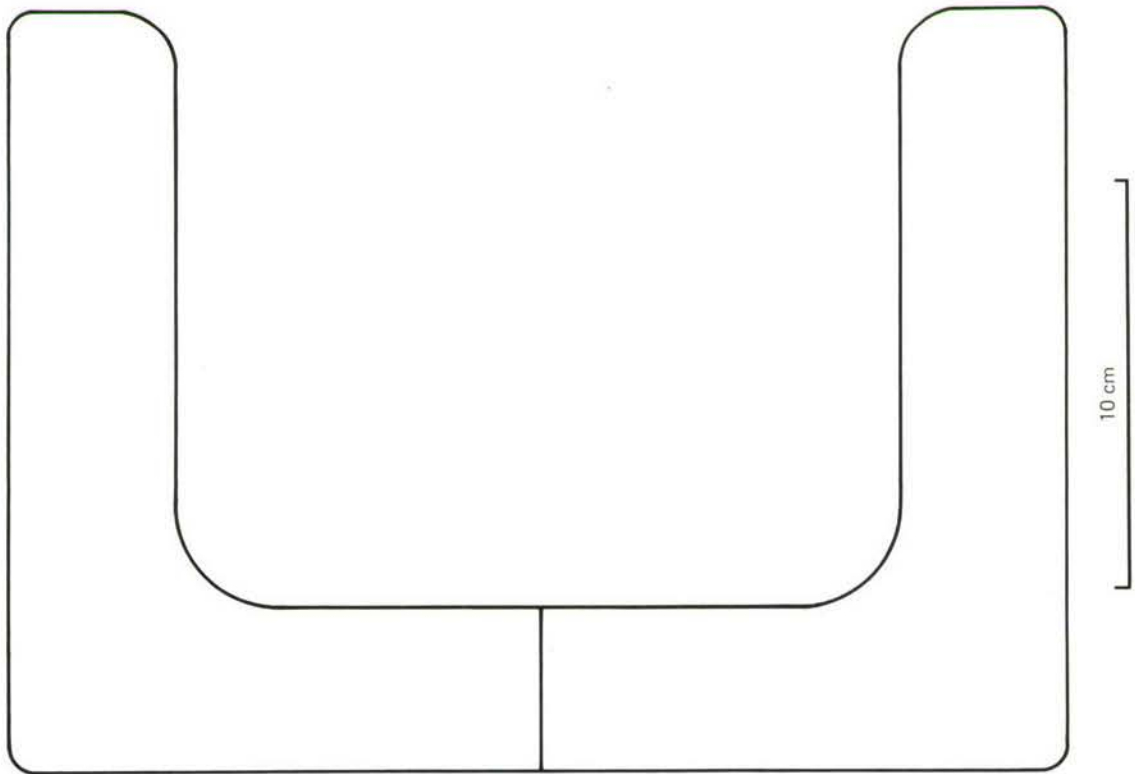


Fig.16 Template

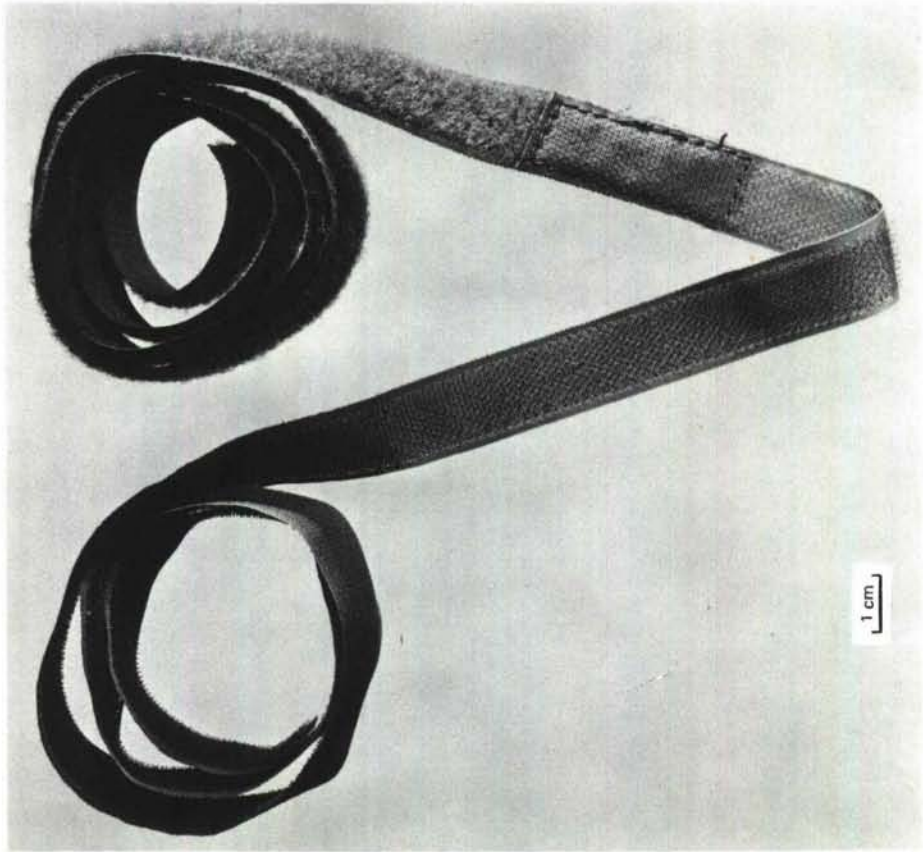


Fig.17 'Velcro' waist belt

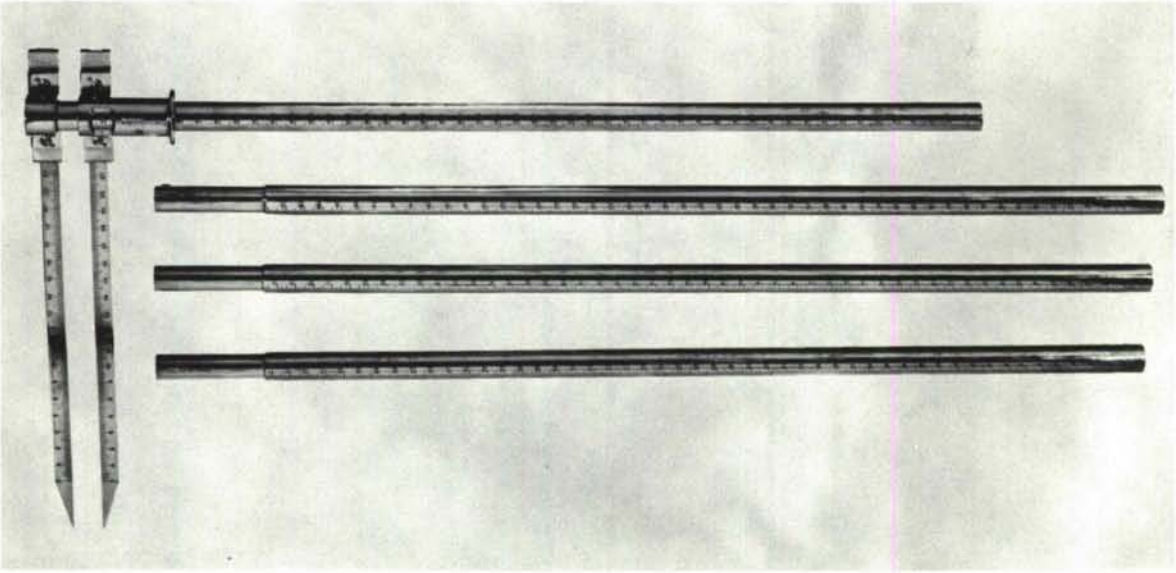


Fig.19 Standard anthropometer



Fig.18 Harpenden skinfold caliper

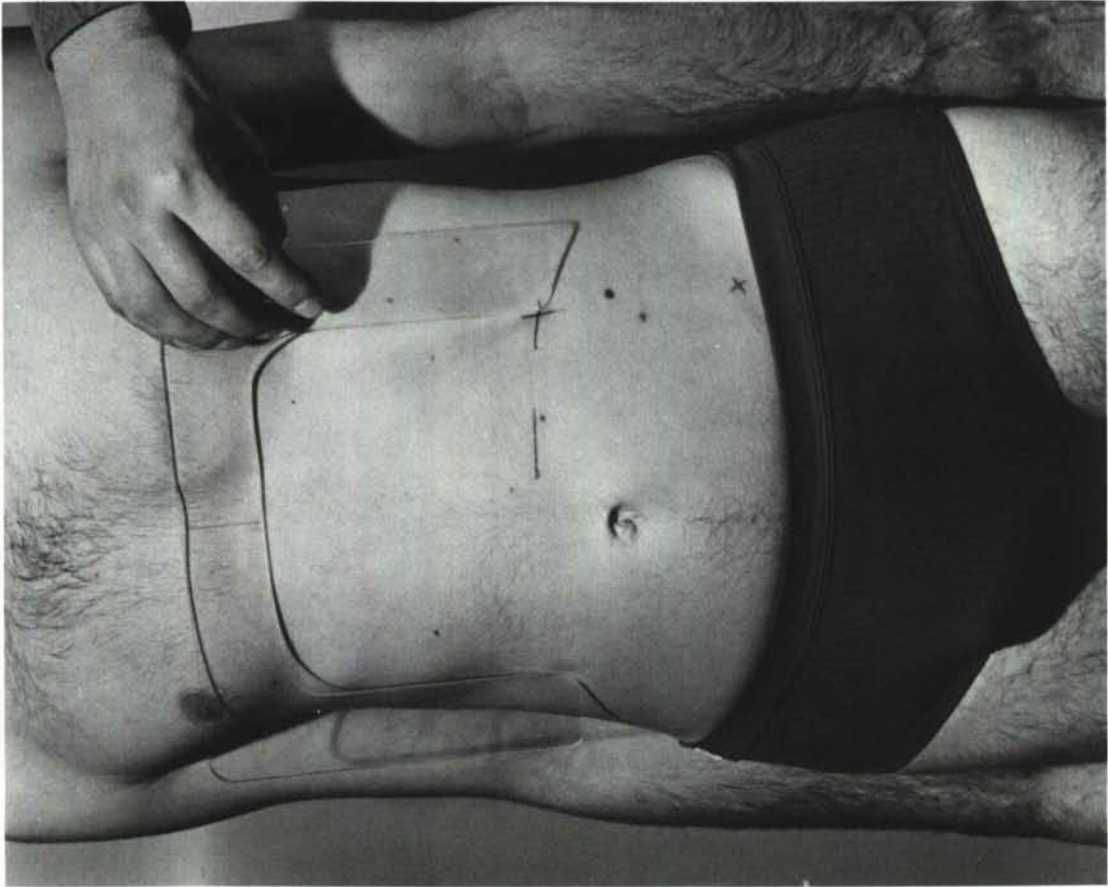


Fig.20 Waist marks – use of template

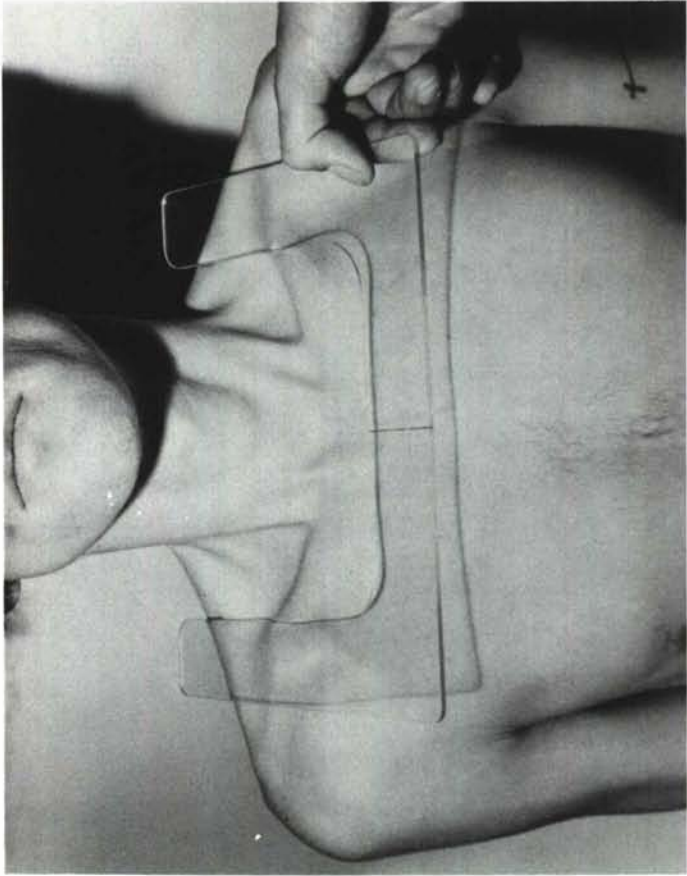


Fig.21 Shoulder marks – use of template



Table		Table	
A	Shoulder marks 90 mm each side of midline	H	Horizontal waist line mark
B	Cervicale mark	J	Ventral waist mark 90 mm from midline
C	Acromial mark	K	Dorsal waist mark 90 mm from midline
D	Biceps skinfold mark	L	Suprailiac skinfold mark
E	Triceps skinfold mark	M	Wrist mark
F	Midpoint between acromial mark and elbow mark	N	Knee mark
G	Elbow mark	O	Subscapular skinfold mark
			62
			60

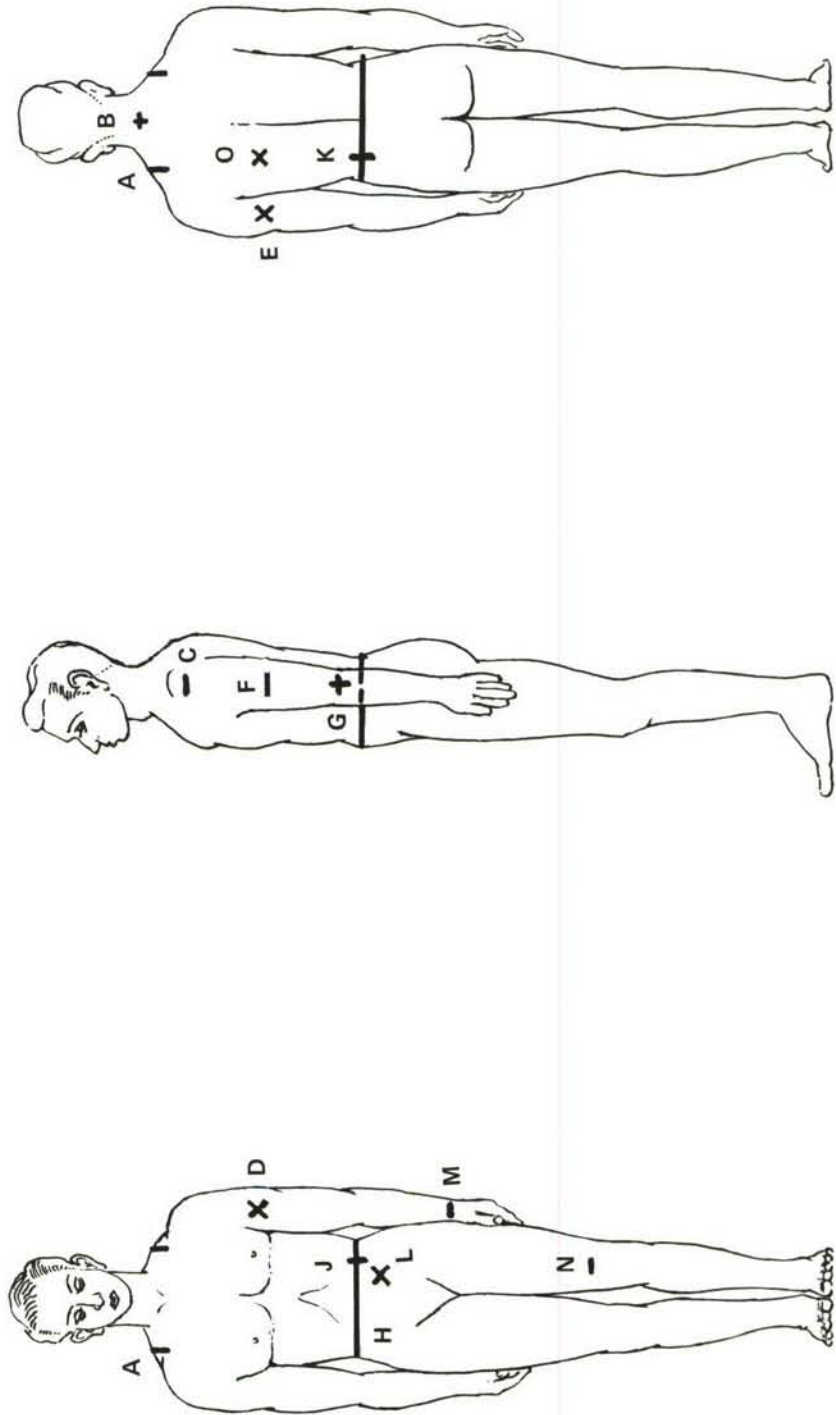


Figure 22a









Table		Table	
A	Head breadth	K	Pupil to vertex
B	Bitrignon — coronal arc	L	Trignon to pupil, vertical
C	Head circumference	M	Nasion to menton, vertical
D	Bitrignon diameter	N	Head length
E	Menton to vertex	O	Trignon to brow ridge, horizontal
F	Trignon to vertex	P	Trignon to back of head
G	Trignon to menton, vertical	Q	Trignon to menton, horizontal
H	Nasion to vertex	R	Menton to back of head
J	Trignon to Nasion, vertical	S	Maximum head diagonal from menton
			50

Table	
48	
47	
46	
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Table	
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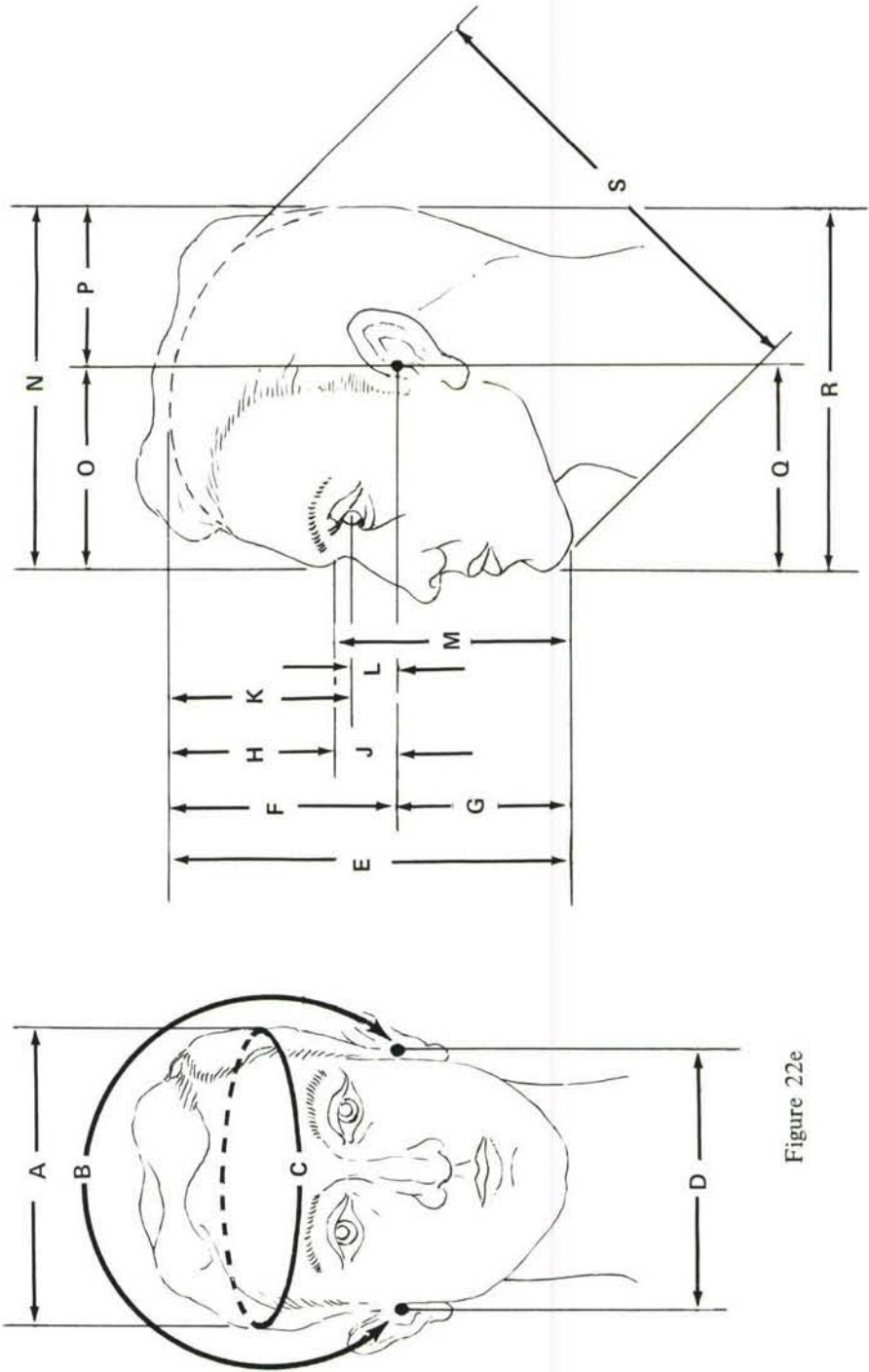


Figure 22e

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15. Abstract  This survey was undertaken to provide up-to-date information on the body measurements of Royal Air Force aircrew. This information is required for cockpit workspace and functional clothing sizing studies.  A team of two trained measurers, using a specially designed anthropometric rig, took 63 body measurements of each of 2000 Royal Air Force aircrew between the ages of 18 and 45 at RAF stations in England. These measurements, recorded during an eighteen month period starting in January 1970, are summarised in the form of a percentile table, mean, standard deviation, range and coefficient of variation for each measurement. The statistical summary for each measurement is accompanied by a photograph illustrating the technique of measurement together with a written description of the measuring procedure. The apparatus used is fully described and the organisation of the survey is briefly discussed.			



<p>AGARDograph No.181 Advisory Group for Aerospace Research and Development, NATO AN ANTHROPOMETRIC SURVEY OF 2000 ROYAL AIRFORCE AIRCREW 1970/71 by C.B.Bolton, M.Kenward, R.E.Simpson, G.M.Turner Published December 1974 86 pages</p> <p>The survey was undertaken to provide up-to-date information on the body measurements of Royal Air Force aircrew. This information is required for cockpit workspace and functional clothing sizing studies.</p> <p>A team of two trained measurers, using a specially designed anthropometric rig, took 63 body measurements of each of 2000 Royal Air Force aircrew between the ages of 18 and 45 at RAF stations in England.</p> <p>P.T.O.</p>	<p>AGARD-AG-181 572.512.1:358.43: 629.73.043:613.69</p> <p>Anthropometry Surveys Flight crews Air force personnel Percentiles Cockpits Flight clothing</p>	<p>AGARDograph No.181 Advisory Group for Aerospace Research and Development, NATO AN ANTHROPOMETRIC SURVEY OF 2000 ROYAL AIRFORCE AIRCREW 1970/71 by C.B.Bolton, M.Kenward, R.E.Simpson, G.M.Turner Published December 1974 86 pages</p> <p>The survey was undertaken to provide up-to-date information on the body measurements of Royal Air Force aircrew. This information is required for cockpit workspace and functional clothing sizing studies.</p> <p>A team of two trained measurers, using a specially designed anthropometric rig, took 63 body measurements of each of 2000 Royal Air Force aircrew between the ages of 18 and 45 at RAF stations in England.</p> <p>P.T.O.</p>	<p>AGARD-AG-181 572.512.1:358.43: 629.73.043:613.69</p> <p>Anthropometry Surveys Flight crews Air force personnel Percentiles Cockpits Flight clothing</p>
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